UNITED STATES MARITIME SERVICE

UNITED STATES

MARITIME SERVICE

Hospital Corps School Manual

PREPARED BY TRAINING ORGANIZATION

U.S. WAR SHIPPING ADMINISTRATION

October 1945

For sale by Superintendent of Documents
Washington 25, D. C.

FOREWORD

This manual is intended to serve as a textbook for students in residence at the United States Maritime Service Hospital Corps School, and as a reference book for graduates of that School when serving aboard cargo ships.

The U. S. Maritime Service Hospital Corps School was established in October 1942, as one of the first medical projects of the Training Organization, War Shipping Administration. The School has a twofold purpose, first, to instruct persons in the duties of a pharmacist's mate on a merchant ship, and second, to train medical attendants, hospital apprentices, and pharmacist's mates for employment at Training Stations of the Training Organization. This program involves courses of basic instruction for the novice and refresher courses for persons who have had some training in medical techniques.

The war emphasized the need for improved medical service on cargo ships at sea, because of the following situations:

First, the number and effectiveness of enemy submarines and air attacks on American merchant ships caused a very large number of casualties among merchant seamen. Indeed, for a considerable period both the number of deaths and injuries in the merchant service were higher than in any of the other branches of the armed services.

Second, in addition to the losses of experienced manpower resulting directly or indirectly from enemy action, the tremendous increase in the size of the American merchant fleet, which resulted from the building program of the Maritime Commission, required that unceasing efforts be made both to recruit experienced seamen and to train inexperienced candidates. The successful prosecution of the war depended in no small part upon the conservation of experienced seaman manpower. Hence, every means had to be explored to improve the manpower situation, and the provision of an augmented medical service afloat seemed to be a factor of obvious significance, both in the reduction of disability and the encouragement of an improved morale.

Third, no completely satisfactory answer had ever been found to the perennial problem of providing medical care for the crews of cargo ships at sea. The best prewar solution of this question was found in a combination of the following two factors: first, the requirement that candidates for officer's license demonstrate a basic familiarity with the principles of First Aid; and second, the availability of medical advice

by radio. The latter is not obtainable during wartime because of the necessity of imposing radio silence, and even in peacetime is not infrequently unavailable because of circumstances such as inability to contact advisory stations because of distance or weather conditions. The detail of a graduate physician to each cargo ship of America's vast and constantly growing merchant fleet was as obviously impossible during the war as it is during peace.

Therefore, the only tenable plan to improve medical service on cargo ships at sea had to be based on improving the medical efficiency of some member of the ship's regular complement. This could only be accomplished by intensified training through the medium of a much more extensive training program than is implied by the instruction in First Aid required of candidates for officer's license. Because of the shortage of licensed officers, it was not expedient to enroll such officers in more advanced medical training classes.

It is obvious that a layman, even though he may have received special training in certain basic medical techniques, can assume none of the legal prerogatives or responsibilities of a licensed physician. The position of such a layman is limited to the circumstance that he is better qualified than other available persons to undertake emeregency measures for the relief of sickness or injury. Such a trained layman has, when compared with a less well trained layman, such an unusually large store of practical knowledge and experience in medical matters as to be able to handle medical emergencies that may arise at sea in a more satisfactory manner than would otherwise be the case.

Since the size of the crew of a ship is limited by a number of factors such as crew's quarters and life boat space, it was not feasible to add an additional member to the crew, whose full time would be limited to medical duties. Nor, could the addition of such a person be justified, since on a cargo ship there would not be enough medical duties to occupy his full time, and he would be largely a supernumerary unless he had other duties to perform.

Therefore, in order that the provision of improved medical service at sea might be stabilized on the soundest possible commercial basis, it was decided to combine the duties of pharmacist's mate with some other rating. It was observed that the vast majority of cargo ships carried a purser—"supercargo". The wartime purser's duties on board a cargo vessel were not sufficient to keep his time fully occupied at sea. Nor, being a staff officer, did he have to stand watches. He, therefore, was in the best position of any crew member to assume the part-time duties entailed by an improved medical service. Arrangements therefore were made to include the complement of ships operated in the offshore

trade in the interest of the War Shipping Administration, the staff officer grade of Purser-Pharmacist's Mate.

The duties of the Purser-Pharmacist's Mate afloat are concerned both with measures of preventive and therapeutic medicine. An outstanding example of the significance of his duties is the part he played in the task of immunizing merchant seamen in accordance with the requirements imposed by military and other authorities. The accomplishment of this task was possible only because a considerable part of it was carried on by Purser-Pharmacist's Mates at sea. The Purser-Pharmacist's Mate was indispensable in other roles as well, for instance, in the administration of penicillin, blood plasma and other preparations requiring basic training in certain medical techniques, and which were instrumental in materially reducing temporary and permanent disability among merchant seamen, and thereby saving countless work hours. The Purser-Pharmacist's Mate made a well merited mark in speeding up the tempo and efficiency of the war effort in many other ways, for instance, by facilitating quarantine procedures, improving ship sanitation, keeping better medical records and otherwise improving morale afloat.

The development of the Hospital Corps School and its success in rapidly and effectively training a very considerable number of graduates, is a tribute to the loyalty and untiring efforts of the staff of the School and others concerned with the numerous details of its operation, and the direct result of the encouragement and sympathetic understanding given to all phases of the project by Emory S. Land, Administrator of the War Shipping Administration, Deputy Administrator Edward Macauley, and Assistant Deputy Administrator for Training Telfair Knight.

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Chief Medical Officer, WSA

PREFACE

In the preparation of this manual, effort was directed toward the preparation of a concise unit of information that would serve for both instructional purposes and as a quick reference in time of emergency. Its use as a reference should be limited to those familiar with its entire contents, preferably by study at the U. S. Maritime Service Hospital Corps School, or to those with equivalent training. The information presented is intended for use in situations where professional facilities are unavailable. The scope of the subject matter covered in this book is extremely broad and considerable condensation was necessary to limit the book to its present size. For further information the reader is referred to standard textbooks covering the several subjects presented and also to a companion book soon to be published, the revised edition of "The Ship's Medicine Chest and First Aid at Sea".

Discussions of disease and treatment designed for use by men with limited training and experience must obviously be limited to conform with their training and experience. In so far as possible this book has omitted references to conditions which need not concern the Merchant Marine Hospital Corpsman in his capacity of providing emergency medical care. Likewise reference to specific disease entities have been avoided because of difficulty of diagnosis. In so far as possible diseases have been treated from the point of view of their symptoms and whenever possible diseases with similar treatments have been grouped together to prevent uncertainty and confusion in the minds of the Hospital Corpsmen. The drugs and equipment necessary for the treatments and procedures recommended have been limited. With but few additions these supplies are those that are ordinarily available on United States merchant vessels carrying Purser-Hospital Corpsmen. The equipment that would be required to perform the laboratory procedures will probably not be available on most vessels. This section of the book, however, is intended for instructional purposes in background subjects.

Acknowledgement is herewith expressed to the entire staff of the United States Maritime Service Hospital Corps School for their efforts in the preparation of this text. Particular credit is due to Senior Assistant Surgeon Burton E. Kintner, USPHS (R); Senior Assistant Sanitarian Robert J. Ollry, USPHS (R); Senior Assistant Nurse Officer Clarice M. Russell, USPHS; Lt. (jg) Theodore R. Lozier, Hospital Corps, USMS, and Ensign James H. Birnie, Hospital Corps, USMS, for

their assistance in the preparation of this text. The illustrations were drawn by Lt. (jg) Theodore R. Lozier.

Assistant Surgeon General Justin K. Fuller, USPHS, Dr. Laurence E. Hines, Associate Professor of Internal Medicine, Northwestern University Medical School, Medical Director Richard B. Holt, USPHS, and Medical Director Carl E. Rice, USPHS are thanked for their criticisms and suggested alterations of the manuscript.

It is also appropriate to express appreciation to Medical Director Richard B. Holt, USPHS, formerly Chief Medical Officer, Sheepshead Bay Training Station; Surgeon Sidney S. Heilweil, USPHS (R), formerly Hospital Corps School Training Officer; and Lt. Alton D. Trippe, Hospital Corps, USN, Hospital Corps Administrative Officer, United States Maritime Service. These men were instrumental in planning and organizing the Hospital Corps School, as well as in guiding its destiny during its early and particularly trying phases.

Robert K. Maddock
Senior Surgeon, USPHS
Hospital Corps School
Training Officer

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WEIGHTS, MEASURES AND APPROXIMATE EQUIVALENTS

METRIC WEIGHTS

1 milligram (mg.), 0.001 gram	= 1/60 grain
1 centigram (cg.), 0.01 gram	= 1/6 grain
1 decigram (dg.), 0.1 gram	= 1½ grains
1 gram (Gm.)	= 15 grains
1 kilogram (Kg.), 1,000 grams	= 35 ounces, or 2⅕ pounds

APOTHECARY WEIGHTS

1 grain (gr.)	= 0.065 grams
1 dram (dm.) (ʒ), 60 grains	= 4 grams
1 ounce (oz.) (℥), 480 grains	= 30 grams

METRIC VOLUMES

1 cubic centimeter (cc.)	= 15 minims
1 liter (L.) 1,000 cc.	= 32 ounces

APOTHECARY VOLUMES

1 minim (m.)	= 0.065 cc.
1 dram (dm.) (ʒ), 60 minims	= 4 cc.
1 ounce (oz.) (℥), 480 minims	= 30 cc.
1 pint (pt.), 16 ounces	= 500 cc.
1 quart (qt.), 32 ounces	= 1,000 cc.

METRIC LENGTHS

1 millimeter (mm.), 0.001 meter	= 1/25 inch
1 centimeter (cm.), 0.01 meter	= 2/5 inch
1 decimeter (dm.), 0.1 meter	= 4 inches
1 meter (M.)	= 39 inches or 3⅓ ft.
1 kilometer (Km.), 1,000 meters	= 3,280 feet or ⅝ mile

ENGLISH LENGTHS

1 inch (in.), 1/12 foot	= 2.5 centimeters
1 foot (ft.)	= 0.3 meter
1 yard (yd.), 3 feet	= 0.9 meter
1 mile, 5,280 feet	= 1609.3 meters or 1.6 kilometers

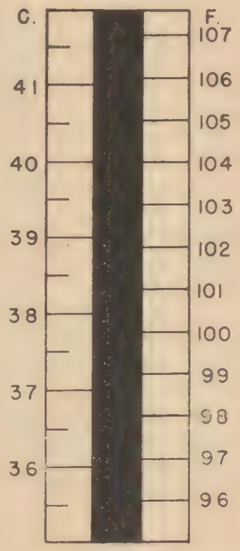
HOUSEHOLD MEASURES AND APPROXIMATE EQUIVALENTS

VOLUME			WEIGHT	
Apothecary	*Metric*	*Household*	*Apothecary*	*Metric*
60 minims	4 cc.	1 level teaspoon (tsp.)	60 grains	4 grams
½ ounce	15 cc.	1 level tablespoon (tbs.)	½ ounce	15 grams
8 ounces	240 cc.	1 glass	8 ounces	240 grams
16 ounces	500 cc.	1 pint	16 ounces	500 grams
32 ounces	1000 cc.	1 quart	32 ounces	1000 grams

TEMPERATURE

COMPARISON OF COMMON POINTS OF TEMPERATURE

	Centigrade	*Fahrenheit*
Freezing Point of Water	0°	32°
Normal Body Temperature	37°	98.6°
Boiling Point of Water	100°	212°

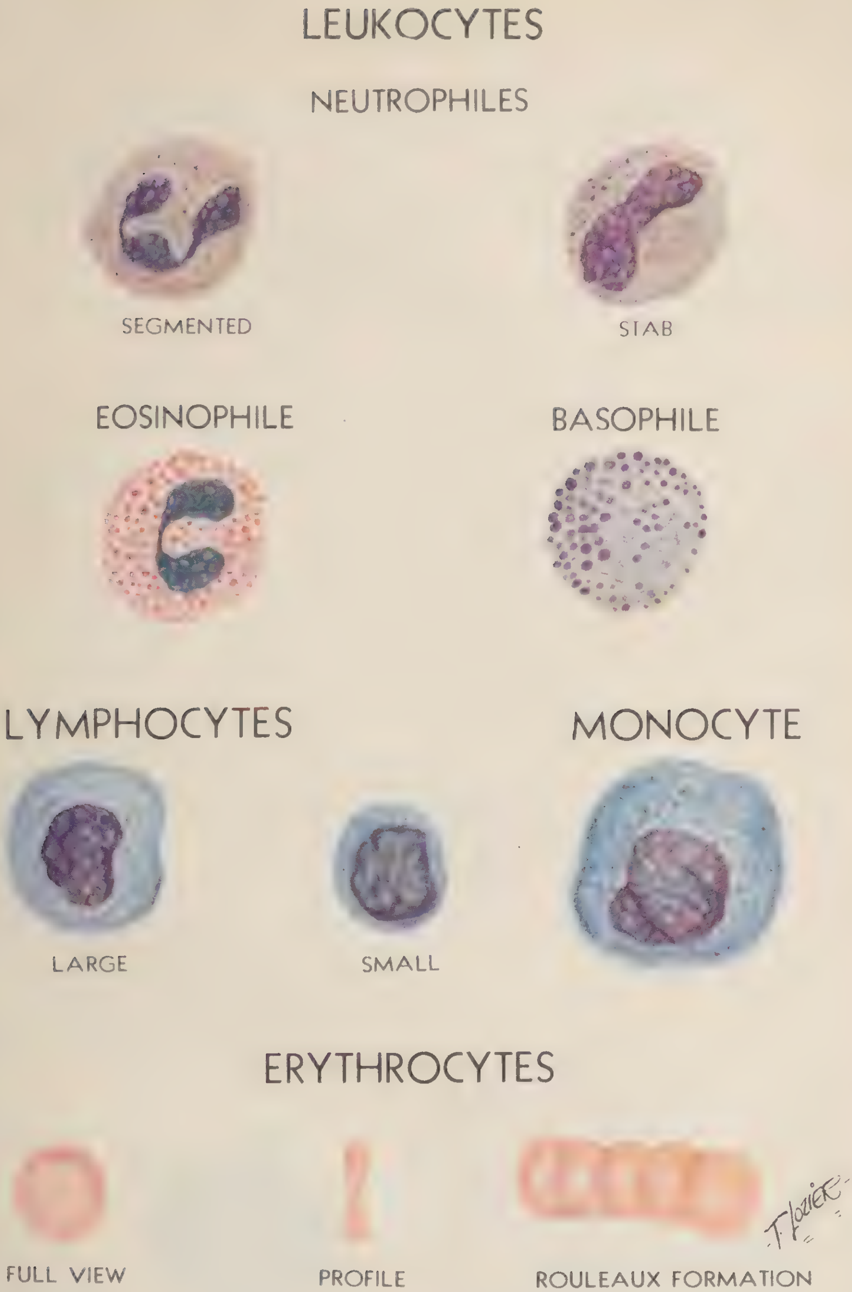


TO CONVERT FAHRENHEIT TEMPERATURE TO CENTIGRADE TEMPERATURE

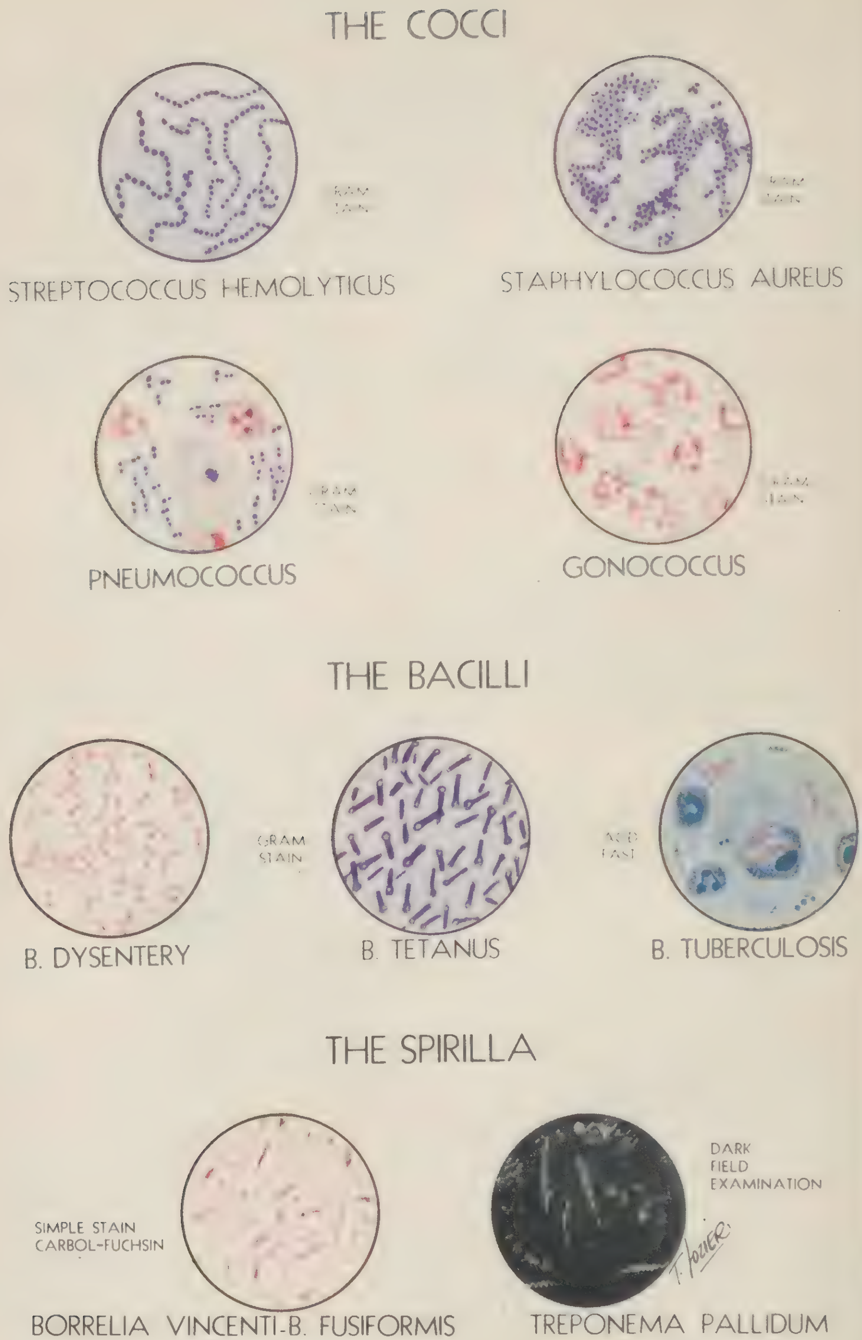
1. Subtract 32 from Fahrenheit temperature
2. Multiply the difference by 0.555
   The product is the Centigrade temperature

TO CONVERT CENTIGRADE TEMPERATURE TO FAHRENHEIT TEMPERATURE

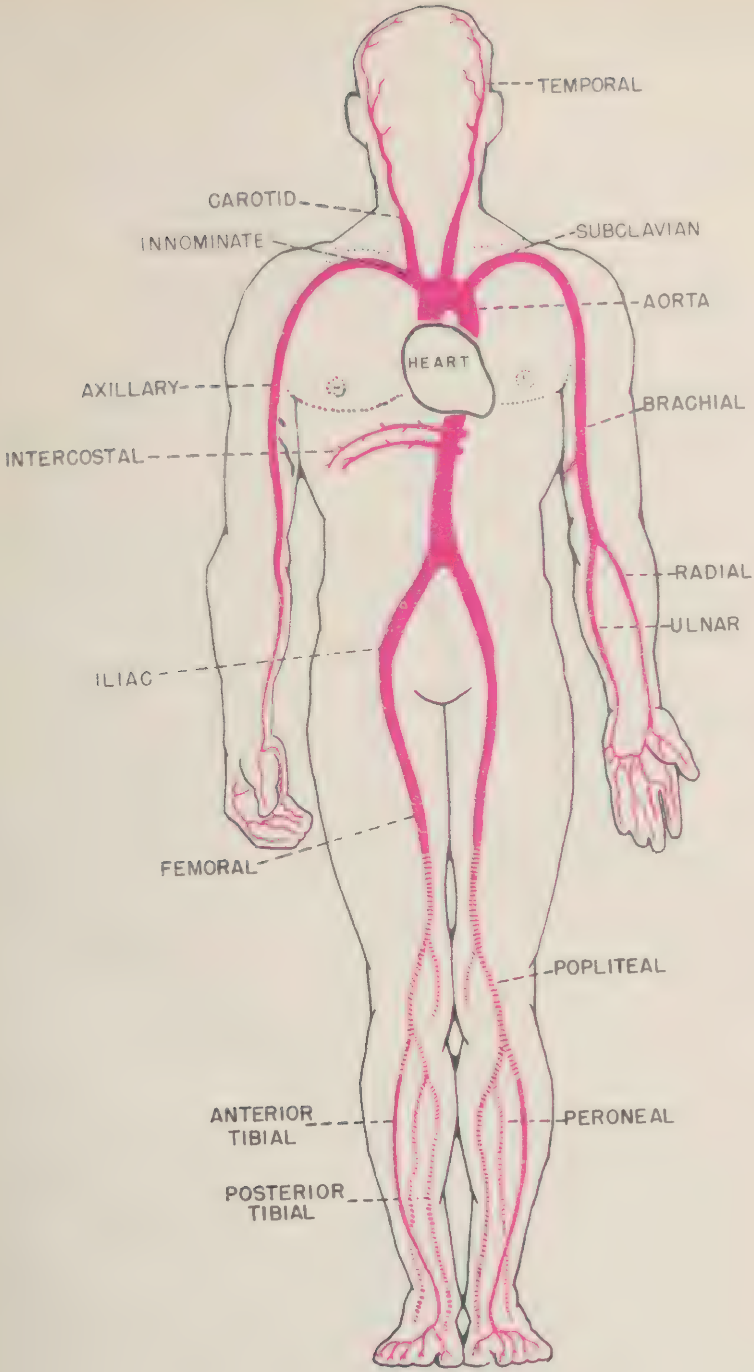
1. Multiply the Centigrade temperature by 1.8
2. Add 32 to the product
   The sum is the Fahrenheit temperature


LEUKOCYTES
NEUTROPHILES
SEGMENTED
STAB
EOSINOPHILE
BASOPHILE
LYMPHOCYTES
MONOCYTE
LARGE
SMALL
ERYTHROCYTES
FULL VIEW
PROFILE
ROULEAUX FORMATION
T. Lozier

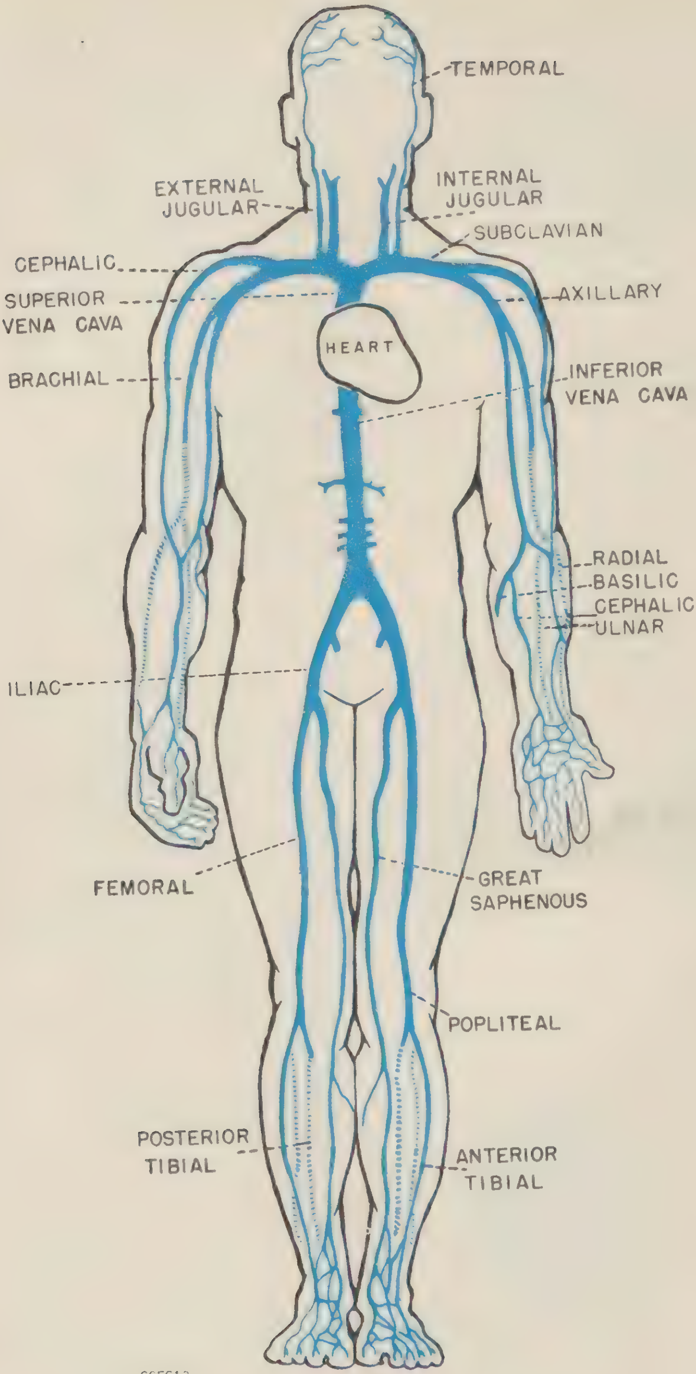
Blood Cells



Common Pathogenic Organisms



Schematic Diagram of the Principal Arteries



Schematic Diagram of the Principal Veins

Chapter I

SYNOPSIS OF HUMAN STRUCTURE AND FUNCTION

INTRODUCTION

The ability to use *judgment* is an essential attribute of a Hospital Corpsman. This quality, which distinguishes the superior man from the mediocre man, is determined by the person's sincerity, personality, intelligence, and *background of knowledge*. A mediocre Hospital Corpsman can learn to apply certain treatments or medications, or perform certain techniques mechanically and under constant supervision. A good Hospital Corpsman will learn the reasons for his actions, will have sufficient background to adapt his actions to meet the specific situation, and will be able to function independently when necessary.

This chapter deals with human anatomy, and with the normal functioning of the body. Anatomy is presented not as a distinct academic subject but rather as a basis for the work of the Hospital Corpsman. To aid nature in the repair of a damaged body, one must be able to visualize the normal structure of the body and of the particular part affected. If severe bleeding is to be stopped quickly, the Corpsman must be able to distinguish between arterial and venous bleeding, locate and recognize the vessels involved, and apply proper measures without hesitation. If a severe wound of any type is to be treated, the Corpsman must recognize the structures involved, and must recognize them without much delay. Too frequently the student considers "anatomy" as a complicated subject which is not studied and learned; he expects "to look it up in a reference book when necessary." However, in actual practice he will discover that the "book" is not available, or that he cannot discover the item sought, or that he does not have time or opportunity for reference reading in emergency situations.

This chapter presents only a brief outline of the anatomy and physiology of the human body and thus avoids discussion of some of the more complex body functions. Consideration is limited to such topics as apply directly to the Hospital Corpsman's duties.

VITAL ACTIVITIES OF THE HUMAN BODY

Under ordinary conditions almost anyone can distinguish between a living body and a dead one, but when one is asked to tell exactly

how such a distinction is made he frequently finds it difficult to list reasons for arriving at his conclusion. This failing results in part from the fact that people take the living process for granted and do not attempt to analyze the variety of events which constitute "life." For persons, such as Hospital Corpsmen, who are entrusted with the protection and preservation of life under a wide variety of conditions, a thorough knowledge of the fundamental human vital activities is essential.

A consideration of the human vital processes reveals that normal living bodies show many activities which can be easily observed without the benefit of any special training or equipment. Without making an attempt to list all of these processes or to set them down in their order of importance, attention is directed to the following vital human activities:

(1) *Adaptation*—By this is meant the ability of the body to become adjusted to the environment in which it lives. This is well illustrated by the reaction of the body to temperature changes of the surroundings. As man must maintain his body temperature within a narrow range, usually between 97.3° and 99.1° F. (average 98.6°), man must find ways of making an adjustment to temperatures above or below his normal range, otherwise the results may be fatal. All individuals are aware of the artificial means, such as adding more clothing or taking off clothing, which man employs to protect himself against heat and cold, but far too few are aware of the role played by the body itself in making the adaptation. By regulating the blood supply to the skin, by controlling the secretion of perspiration poured on to the surface, and by other reactions the body so regulates the balance between heat production and heat loss as to maintain a constant body temperature in spite of variations in the environment. This constitutes only one of the many adjustments the body makes daily throughout life and serves to illustrate the process called *adaptation* without which life is impossible.

(2) *Respiration*—consists of taking in air containing oxygen and the elimination of the waste gas, carbon dioxide. This exchange of gases, accomplished by means of the lungs, is usually spoken of as breathing and constitutes one of the easily recognized vital activities. Not only is this process constantly taking place but the rate of breathing must be regulated to provide the body with the correct amount of oxygen to maintain the body functions. Failure of this activity, even for a short period of time, will result in death, but the Hospital Corpsman soon learns that by employing *artificial respiration* he may restore breathing

and save the lives of persons in whom the process of respiration has been temporarily interrupted.

(3) *Irritability*—is thought of as the ability of the body to respond to stimuli. This reaction is made possible through the working of the brain and associated nerves. While the extent of the response to any given stimulus may vary greatly in different individuals, the ability to respond is present in all normal living bodies. Irritability is closely associated with adaptation and frequently warns the body of factors in the environment which would be injurious.

(4) *Metabolism*—is the process through which physical and chemical changes are constantly taking place in the living body. Those changes which tend to build up the body are spoken of as *anabolic* changes (anabolism) and those changes which tend to tear down the body are called *catabolic* changes (catabolism). The status of the individual at any given time is the result of a balance between the anabolic and catabolic forces. This balance is spoken of as the level of metabolism Some of the factors going to make up this complex are: the utilization of food and oxygen, the release of energy, the elimination of waste, and the repair of damaged tissues. It is well known that most individuals show remarkable powers of repair of the body following injury, indicating that such individuals possess a favorable metabolic balance.

(5) *Excretion*—is the elimination of waste products and, while a part of the complex reaction termed "metabolism," is important enough to warrant special consideration. The elimination of metabolic waste products is constantly taking place in several different organs of the body. Some of the waste products are very toxic and their accumulation brings about serious results. For example, accumulation of nitrogenous wastes, resulting from damage to the kidneys, creates a serious and often fatal condition known as uremic poisoning.

(6) *Circulation*—is the process of distributing various materials throughout the body, and is accomplished by the blood and lymph. The importance of this process can easily be recognized when one considers that regardless of how much oxygen is present in the lungs, the foot cannot make use of this oxygen unless it is transported there by the blood stream. The pumping action of the heart keeps the blood circulating through the vessels of the body, hence the heart rate is frequently an important index of the condition of the circulating mechanism.

(7) *Growth*—means the increase in size or complexity through the addition and rearrangement of material in living tissue. Growth is usually considered as the total increase in size of the body, but it should

be remembered that the replacement of material in local areas following injury occurs through the same growth processes. The self-replacement of damaged parts of the body is limited in extent; for example, man will not grow a new arm or new leg, but the repair of damaged areas through growth of new tissues is often remarkable in extent. One of the duties of the Hospital Corpsman is to see that this growth process is allowed to function to the best of its ability.

There are other vital activities such as *reproduction* and *development,* which are part of the living complex, but which can be recognized only by observation over extended periods of time. The purpose of the above presentation is simply to call attention to some easily observed vital processes which the Hospital Corpsman should understand clearly before attempting a more detailed consideration of the physiological factors involved.

THE CELL

Turning to a more detailed consideration of the body functions, one finds that the ultimate answer to all questions regarding activity are to be found in an analysis of the functions of the *cells,* for cells are recognized as the structural, functional and developmental units of the body. This statement doubtless causes some confusion because many have never heard of cells and while all of us have seen humans, few have had the opportunity to see human cells. Nevertheless, it has long been recognized that all living bodies are composed of tiny units known as "cells."

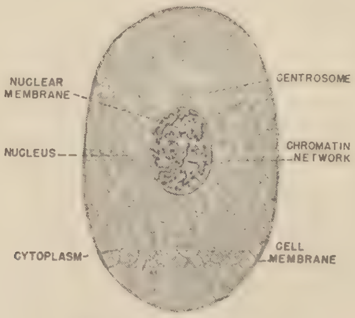


Figure 1. The cell.

A cell is a minute mass of *protoplasm* which is divided into two regions, namely, the *cytoplasm* and the *nucleus.* These two regions can be clearly seen in Figure 1. The cytoplasm forms the groundwork of the cell and contains many intracellular structures which perform specialized functions. Surrounding the cytoplasm is the cell membrane

which permits certain material to enter the cell and excludes other material, thus the membrane is said to be *semi-permeable* and hence regulates the chemical composition of the cell. The *nucleus* is a specialized area considered to be the region which controls cellular activities.

The cells demonstrate those general vital activities characteristic of living matter, namely, adaptation, respiration, irritability, excretion, metabolism, growth, development and reproduction. In addition some body cells perform specialized functions. Some examples of these specialized functions are as follows. Cells which serve to manufacture and give off products useful to the body are *secretory* cells, for example, the cells of the salivary glands. Certain of the blood cells possess the power of movement and are spoken of as *ameboid* cells. These cells are quite important in our systems of defense because they take in and destroy bacteria through a process known as phagocytosis. Some cells possess the power of shortening or contracting; muscles are composed of such cells and they provide movement for the body parts. Still other cells receive stimuli and transmit them to other parts of the body, hence are specialized for *conduction*. Cells of the brain and nerves are of this type. Thus within the body, different types of cells have different jobs to perform and a more detailed study would reveal that their structure is so modified as to make it possible for them to perform their special function.

ORGANIZATION OF CELLS

It is doubtless already clear that no cell or group of cells in the body lives and functions alone but rather there must be some organization between large groups of cells. Such is the case when groups of cells together with their intercellular material work to perform a common function; they are spoken of collectively as a *tissue*. Attention should be called to the fact that in this association, the intercellular material is in many cases equally as important as are the cells and frequently determines the nature of the tissue. The solid intercellular material of bone and the liquid intercellular material of blood impart to these tissues the characteristics for which they are best known. The cells of the body are organized into tissues which may be divided into four groups, namely, (1) epithelial tissue, (2) muscle tissue, (3) connective tissue, and (4) nerve tissue. The *epithelial tissue* serves as the covering for the exposed surfaces of the body, the lining of cavities and tubes, and as the secretory cells of glands. *Muscle tissue* is specialized for the creation of movement of parts of the body and is found attached to the skeleton, in the heart, and in the walls of some other internal organs. *Connective tissue* is composed of an extremely wide variety of cell types.

It forms such structures as the tissue fibers which bind the body parts together (connective tissue proper) and bone, cartilage, blood and fat. The tissue specialized for the reception of stimuli and the conduction of impulses is known as *nerve tissue* and constitutes one of the most highly specialized tissues of the body. Examples of the various types of tissues can be seen in Figure 2.

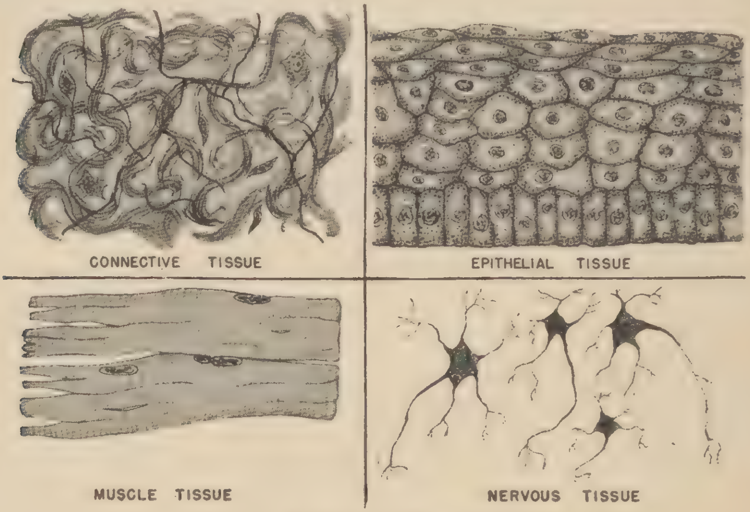


Figure 2. Tissues.

The tissues of the body are further organized so that groups of tissues work together to perform a common function, such groups of tissues being known as *organs*. A well known example of an organ is the stomach which is composed of epithelial tissue, muscle tissue, connective tissue and nerve tissue all working together in a unified manner to bring about the digestion of food. The example of the stomach is no exception as all of the body organs are composed of many different types of tissues.

As the organs cannot function alone, they are further organized into groups of organs working together as *organ systems*. The latter include the digestive, circulatory, respiratory, reproductive, excretory, muscular, skeletal, nervous and endocrine systems. These systems work together with the end result being the activities of the body as a whole.

CHEMICAL COMPOSITION

Contrary to common belief, the body is composed of the same type of chemical elements as are found in non-living material and contains no chemical element which is peculiar to the living body. It is interest-

ing to note however that of the 92 chemical elements found in the non-living world, only 14 to 16 can be found in the human body, but because of the wide variety of combinations these elements can make, there are thousands of known compounds present in the body.

The most abundant and most important chemical compound present in the body is water. It comprises between 60 and 99 per cent of the various tissues of the body. Other compounds of the body are either in solution or suspension in water, hence every chemical reaction occurring in the body is dependent upon the presence of water. The importance of water may be seen very clearly in cases of dehydration where every body reaction is retarded due to the absence of water, and it is well established that individuals can live much longer deprived of food than when they are deprived of water.

A second group of compounds found in the body are the inorganic salts of which sodium chloride (ordinary table salt) is the most common. Although inorganic salts are present in low concentrations, only slight variation in the amount is tolerated by the body. The harmful effect of variations in amount is clearly seen in cases of heat exhaustion which is brought on primarily by the loss of salt (sodium chloride) from the body. The effect of changes in the balance of the salts is seen in the convulsions brought on by a lowering of the calcium content of the blood. Here the absence of a single element causes a heightened irritability of the muscles to such an extent that they are thrown into spasms which if not corrected may end fatally.

The organic compounds present fall into three major groups: carbohydrates, fats, and proteins. The *carbohydrates* are the starches and sugars. These are composed of carbon, hydrogen and oxygen. The *fats* are likewise composed of carbon, hydrogen and oxygen but the proportions are different. The *proteins* are very complex compounds composed of carbon, hydrogen, oxygen, nitrogen and other elements such as sulphur and phosphorus. Each animal is composed of its own specific proteins, fats, and carbohydrates. When these compounds are ingested, they must be broken down to simpler compounds and then reconstructed in the specific form required by the body. Chemical transformations which alter the specific arrangement of compounds are constantly occurring in the body. After being altered, the compounds are used for the production of energy, used in building protoplasm, or stored for future use.

There are many other types of compounds such as enzymes, hormones, and vitamins found in the body, but it is beyond the scope of this study to discuss them here.

BODY REGIONS

The anatomy of the human body can be approached from several points of view. The Hospital Corpsman will find it valuable to learn regional anatomy. This is necessary because injury to any body area may involve not only one system but perhaps several systems in that region. Further, variations in one organ frequently exert an influence on adjacent organs, hence a knowledge of adjoining structures is of great importance.

In attempting to describe the position of various structures, use of such terms as above, below, before, and behind is frequently confusing. The confusion arises from the fact that their meaning will vary as the position of the body changes. Hence it is necessary to adopt the use of terms which have exact anatomical meanings. When the body is in the anatomical position, the following general terms are used:

Anatomical position	Body erect, face toward the observer, arms at the sides, palms of the hands forward.
Dorsal (posterior)	Located toward the back.
Ventral (anterior)	Located toward the front, belly side.
Cranial (superior)	Located toward the head, above.
Caudal (inferior)	Located toward the hind end, below.
Medial	Toward the mid-line.
Lateral	Away from the mid-line.
Internal	Located within, on the inside.
External	Located on the outside.
Proximal	Nearer the center, origin, or main mass.
Distal	Away from the center, origin, or main mass.
Deep	Located away from the surface.
Peripheral	Located at or near the surface.

The body is divided into four main regions: the head, neck, trunk and appendages. These body regions together with the common descriptive terms applied to various areas can be seen in Figure 3.

The head is divided into the *face* and *cranium*. The face includes the anterior (front) region of the head from the forehead to the chin. The cranium includes the remainder of the head. The eyes are located in the upper region of the face. They are set in depressions or sockets known as the *orbital cavities* which protect the eyes and associated tissues. For additional protection each eye possesses a pair of eyelids, the upper being more movable than the lower. The nose arises as an elevation between the eyes. At the lower end there are two openings, the *external nares* (nostrils), which serve as an entrance for air during breathing. The nose has a supporting skeletal framework composed of bone and cartilage (gristle). The mouth, located in the lower third of

the face, forms an opening into the *buccal cavity*. This cavity contains the tongue, teeth, hard palate, and the soft palate. Below the mouth is located the lower jaw which serves to open and close the mouth. Sinuses are contained within the bones in the frontal area (above the eyes),

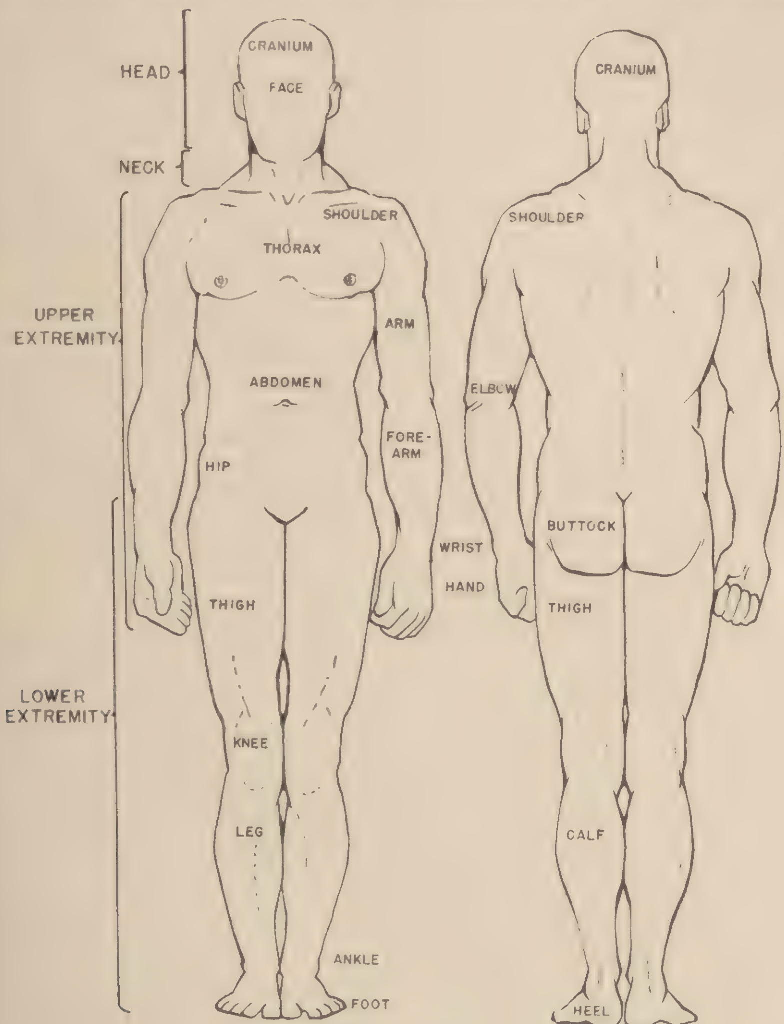


Figure 3. Body regions.

the ethmoid area (between the eyes), and the maxillary area (below the eyes). These sinuses can be thought of as blind extensions of the nasal cavity and are lined with a continuation of the mucous membranes which line the nose. The passage from the nasal cavity to the sinuses

is small and so placed that adequate drainage may be difficult, (Figure 4). On the lateral (side) surfaces of the head are located the ears. Externally there is a semi-rigid *pinna* (trumpet) from which passes the auditory canal leading to the middle ear chamber. Beneath the skin is located the skull which forms a bony box protecting the brain, (Figure 5). The space within the skull where the brain is located is the *cranial cavity.*

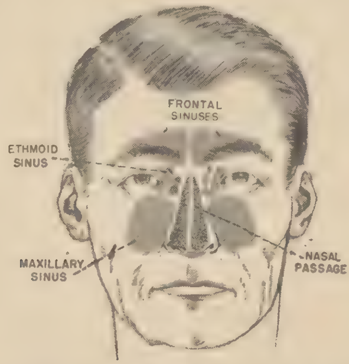


Figure 4. Diagram showing relationships of the paranasal sinuses to surface landmarks and nasal passages.

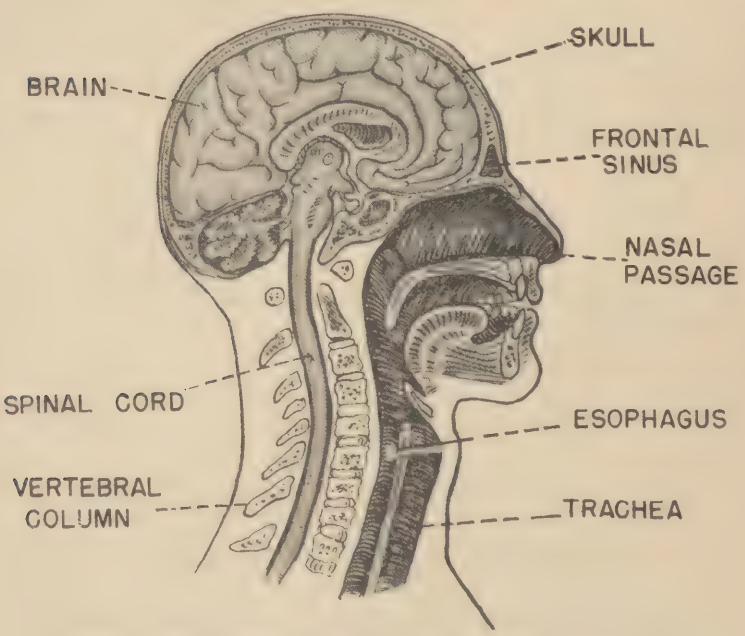


Figure 5. Diagrammatic median section of the head and neck.

The head is attached to the body by means of the neck. Passing through the neck is the *vertebral column* (backbone) which encloses the *spinal cord.* Also passing through the neck is the *esophagus* (food tube), the *trachea* (windpipe), blood vessels and nerves. The neck is held rigid by the vertebral column and large bands of muscle on the dorsal (back) and lateral regions.

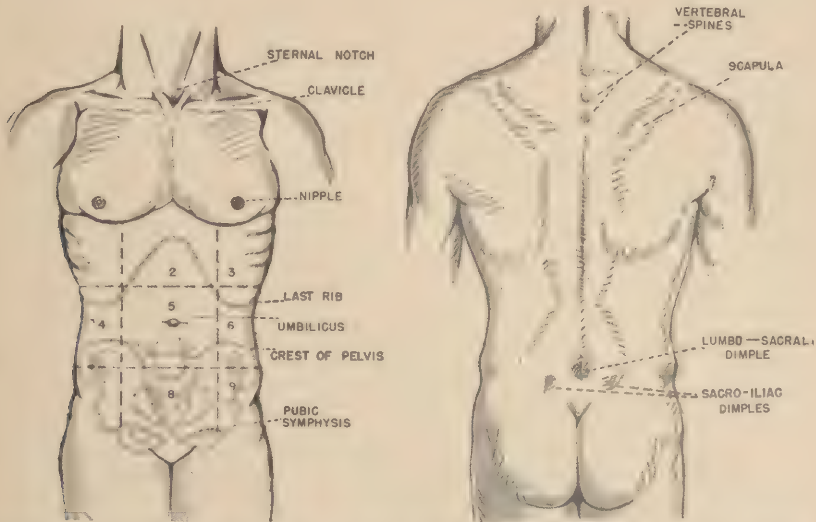


Figure 6. Prominent landmarks of the trunk: 1. right hypochondriac region; 2. epigastric region; 3. left hypochondriac region; 4. right lumbar region; 5. umbilical region; 6. left lumbar region; 7. right iliac region; 8. hypogastric region; 9. left iliac region.

The trunk constitutes the largest of the body regions. The skin, muscles, and bony skeleton of the trunk constitute the *body wall* which encloses the internal organs. The surface of the trunk presents several well-defined points known as *landmarks.* The outstanding anterior landmarks are the *clavicles* (collar bones), *sternal notch* (upper end of the breast-bone), the *nipples,* the *last ribs,* the *umbilicus* (navel), *crest of the ilium* (upper border of the hip), and the *pubic symphysis* (bony prominence above the genitalia), (Figure 6). The posterior landmarks are the *scapulae* (shoulder blades), *vertebral spines* (projections of the backbone), *lumbo-sacral dimple* (depression in the small of the back), and the *sacro-iliac dimples* (depressions just above the buttocks), (Figure 6). The student should locate these points carefully as they will be of value for future study.

For reference purposes the surface of the trunk is divided into *anatomical regions.* The major regions are:

Epigastric	In front of the stomach.
Umbilical	Pertaining to the navel.
Hypogastric	Below the stomach.
Right and left hypochondriac	Below the lowest rib.
Right and left lumbar	Pertaining to the loins.
Right and left iliac	Pertaining to the ilium or hip.

For location of these regions with respect to the landmarks see Figure 6.

In addition to the landmarks and general anatomical regions, specific areas are frequently divided into *quadrants* for descriptive purposes. The method employed is to draw imaginary horizontal and vertical lines through the area so as to divide it into four equal parts. The four quadrants are then named as seen in Figure 7. Such descriptive terms are frequently employed in designating areas of the abdomen and buttocks.

Internally the trunk contains two large cavities. The upper cavity is the *thorax* and the lower the *abdomen.* The two are separated by a dome-shaped sheet of muscle, the *diaphragm,* (Figure 8). The thoracic cavity is subdivided into the *pleural cavities* (lung cavities) and the *pericardial cavity* (heart cavity). The following structures are located in the thoracic cavity: the heart, lungs, the lower portion of the trachea, and the esophagus which passes through the thorax. For the location of these organs see Figures 9 and 10. The liver, stomach, small intestine, large intestine, pancreas, spleen, kidneys, ureters and bladder are located within the abdominal cavity. The dorso-ventral (back to front) relationship of the internal organs can be determined from a study of the cross sections taken at different body levels, (Figure 11).

There are two pairs of appendages spoken of as the upper extremities and the lower extremities. The upper extremity is composed of the shoulder, arm, forearm, and hand. The extremity is supported by a skeletal framework to which muscles are attached. Coursing through the extremity are blood vessels and nerves. The lower extremity is composed of the hip, thigh, leg, and foot. The lower extremity is supported by a skeletal framework, which originates with the hip or pelvis.

Figure 7. Division of a body area into quadrants: 1. L.U.Q. left upper quadrant; 2. R.U.Q. right upper quadrant; 3. L.L.Q. left lower quadrant; 4. R.L.Q. right lower quadrant.

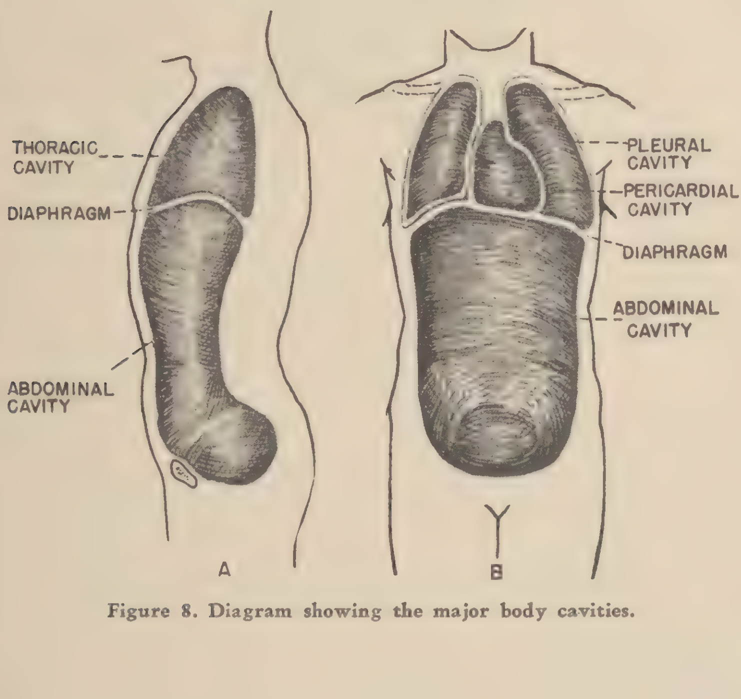


Figure 8. Diagram showing the major body cavities.

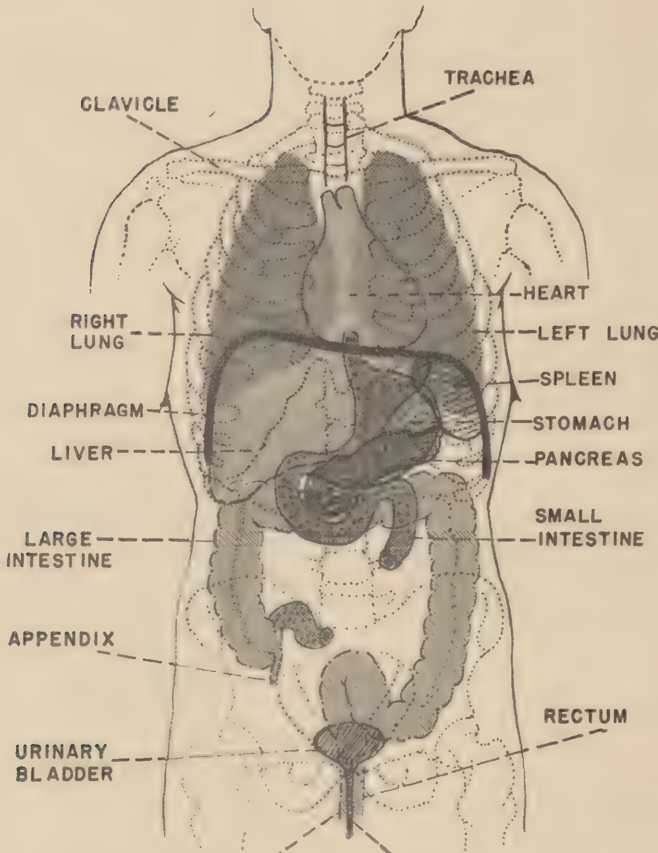


Figure 9. Diagram showing surface relationship of the internal organs, anterior view.

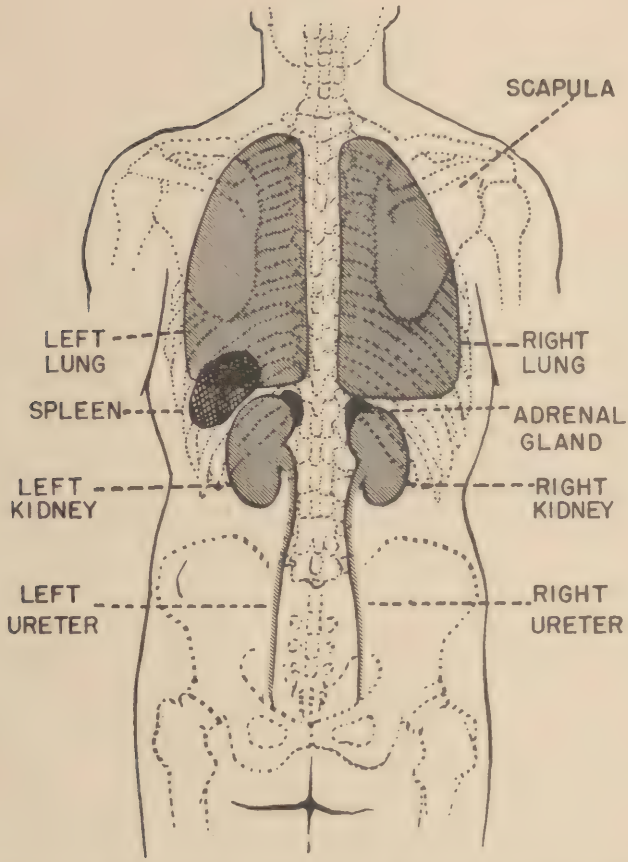


Figure 10. Diagram showing surface relationship of the internal organs, posterior view.

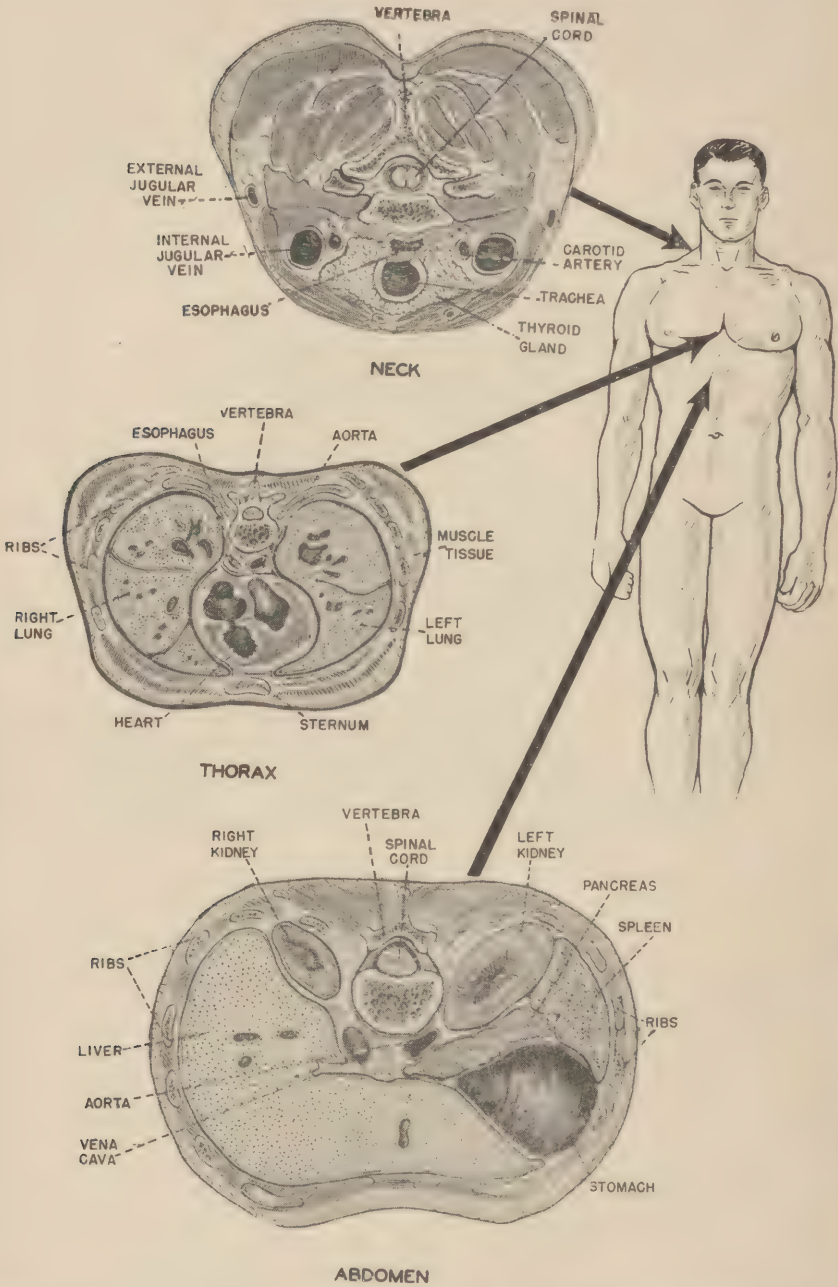


Figure 11. Schematic cross sections of the body. Note: These cross sections are not drawn in relative proportion.

BONES AND JOINTS

Bones form the hard framework of the body known as the *skeleton*. Muscles, attached to this framework, provide for body motion. Further, the skeleton shelters and protects the delicate internal structures, and by holding them in place maintains the body shape. Bone (osseous tissue) is one of the connective tissues. It is specialized in that the intercellular material contains deposited mineral salts which provide rigidity. Calcium phosphate and calcium carbonate are the chief salts with which the intercellular material is impregnated. These mineral salts constitute about 67 per cent of bone. As the individual becomes older, the amount of these salts increases causing the bones to become harder and more brittle. The tensile strength of bone is due to the presence of organic fibers which ramify throughout the tissue. When these fibers are absent, the bone may be easily broken. An example of this is seen in bone which has been subjected to heat that destroys the fibers and leaves the mineral salts intact. On the other hand, the organic fibers devoid of mineral salts are flexible. Bone which has been treated with acid to remove the mineral salts (decalcified) demonstrates this fact very clearly.

There are two types of bone: (1) spongy, and (2) compact. The spongy (cancellous) bone contains numerous spaces or cavities so that it forms a lattice-work type of structure. Compact bone has almost no open spaces but is the same dense structure throughout. Both of these types are usually present in the same bone. This may be seen in a section of a long bone; here the shaft is compact and the internal part spongy, (Figure 12). The amount of spongy and compact tissue varies depending upon the function of the bone. In the medullary canal and spongy tissue of the long bones is located the *marrow*. There are two types of marrow, namely, red and yellow. The red marrow is largely restricted to the region of the articular enlargements and the yellow marrow is present in the medullary canal. The *periosteum* covers all parts of bones except the areas covered by the *articular cartilage*. The periosteum is thin, vascular, and fibrous. New bone is formed from the periosteum during the normal growth period. Likewise, damaged bone is replaced by the periosteum. This membrane is more active in young individuals than in old, which probably accounts for differences in the time required for healing.

The bone cells are supplied with nutrient material from the blood. Blood vessels enter the bone and divide into tiny tubes (capillaries) which run through the *Haversian canals,* (Figure 12). Nutrient material is distributed by way of the canal system which reaches to all parts of

the bone. The Haversian canals are filled with a fluid known as lymph, into which diffuses the nutrient material. By way of the *canaliculi* the canals make contact with the *lacunae*, in which are located the bone cells. The lymph diffuses through these tiny channels until the food material finally reaches its destination.

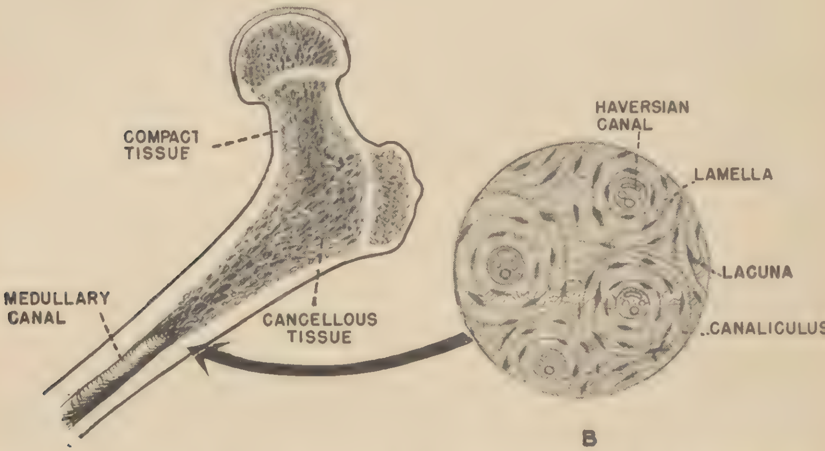


Figure 12. Diagram of bone structure: A. longitudinal section of proximal end of femur; B. microscopic appearance of compact bone.

When a bone is broken there is injury to the osseous tissue, and often to blood vessels and surrounding soft tissues. As a result of the injury there is an increased blood supply to the irritated area. Blood plasma and certain white blood cells enter the area as an exudate from the periosteum and broken bone ends, forming a substance called the *callus*. This substance holds the broken bone ends together. Bone forming cells (osteoblasts) migrate into the callus; later, mineral salts are deposited thus repairing the break. The healing time for bone is longer than that for soft tissue because soft tissue is produced first and then undergoes ossification (impregnation with mineral salts). The bones of children do not fracture as easily as those of adults because they contain less mineral salts, hence are not as brittle. It is important that fractured bones be placed in their normal position to obtain healing without deformity. When healing occurs with the periosteum in an abnormal position growth is misdirected resulting in disfiguration of the bone.

The human skeleton consists of two hundred and six distinct bones. The distribution of these bones in various body regions is seen in the table. Based upon their structure, bones are divided into four classes:

(1) long, (2) short, (3) flat, and (4) irregular. A *long bone* is composed of a hollow shaft and two enlarged extremities, e.g. the *femur*. The shaft is compact bone and the extremities spongy bone with a thin outer cover of compact bone. Within the shaft is a hollow space, the medullary canal. *Short bones* are spongy in texture with a thin outer crust of compact bone, e.g. the *carpals*. *Flat bones* are broad plates of compact bone between which is some spongy bone, e.g. the *scapula*. *Irregular* bones include all bones which do not fit into any of the other groups, e.g. the *mandible*. The surface of each bone bears characteristic elevations and depressions. These serve for the attachment of muscles and articulation with other bones. Each bone can be identified by the presence of these surface markings. The following terms are commonly used to describe these elevations and depressions:

Process—projection or prominence.
Tuberosity—large projection.
Tubercle—small projection.
Spine—sharp slender projection.
Condyle—rounded projection.
Crest—narrow ridge.
Fossa—depression or pit.
Notch—deep indentation.
Foramen—hole or perforation.

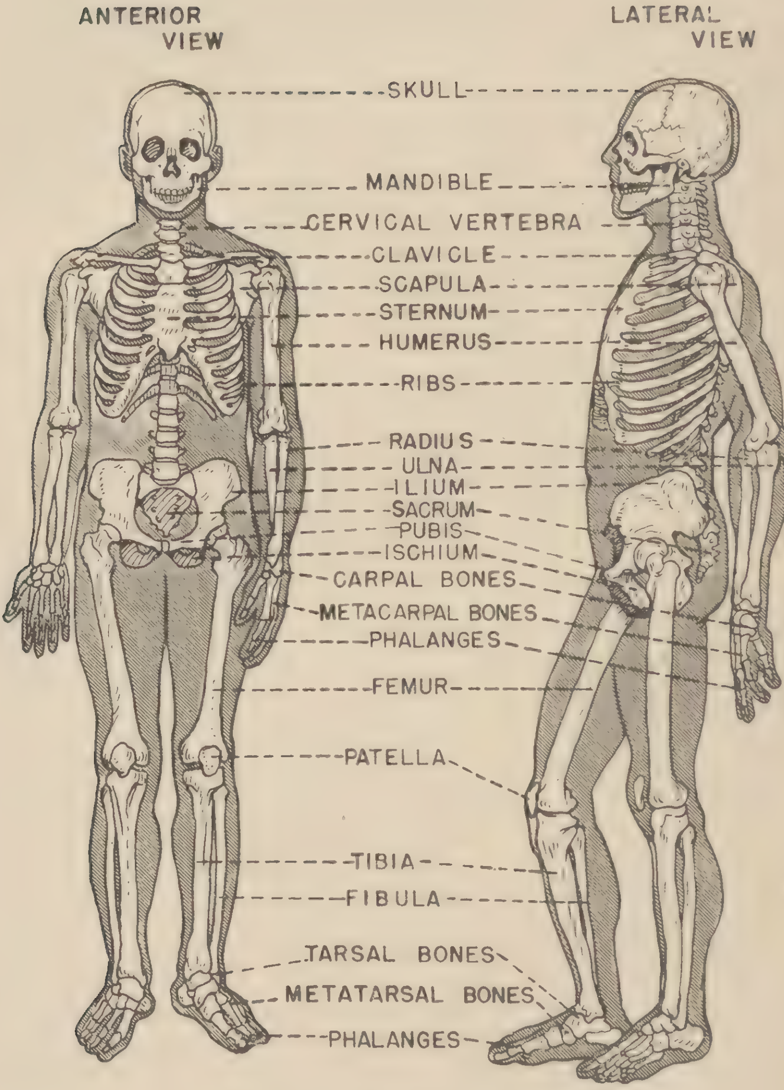


Figure 13. Diagram of the skeleton.

TABLE OF BONES

SKULL	Occipital	1	
	Parietal	2	
	Temporal	2	
	Sphenoid	1	
	Zygomatic	2	
	Ethmoid	1	
	Lacrimal	2	22
	Nasal	2	
	Maxilla	2	
	Mandible	1	
	Frontal	1	
	Vomer	1	
	Palatine	2	
	Inferior Turbinate	2	
HYOID			1
AUDITORY OSSICLES			3 x 2 = 6
VERTEBRAL COLUMN	Cervical	7	
	Thoracic	12	
	Lumbar	5	26
	Sacrum	1	
	Coccyx	1	
RIBS			12 x 2 = 24
STERNUM			1
UPPER EXTREMITIES	Scapula	1	
	Clavicle	1	
	Humerus	1	
	Radius	1	32 x 2 = 64
	Ulna	1	
	Carpals	8	
	Metacarpals	5	
	Phalanges	14	
LOWER EXTREMITIES	Innominate	1	
	Femur	1	
	Patella	1	
	Tibia	1	31 x 2 = 62
	Fibula	1	
	Tarsals	7	
	Metatarsals	5	
	Phalanges	14	
		Total	206

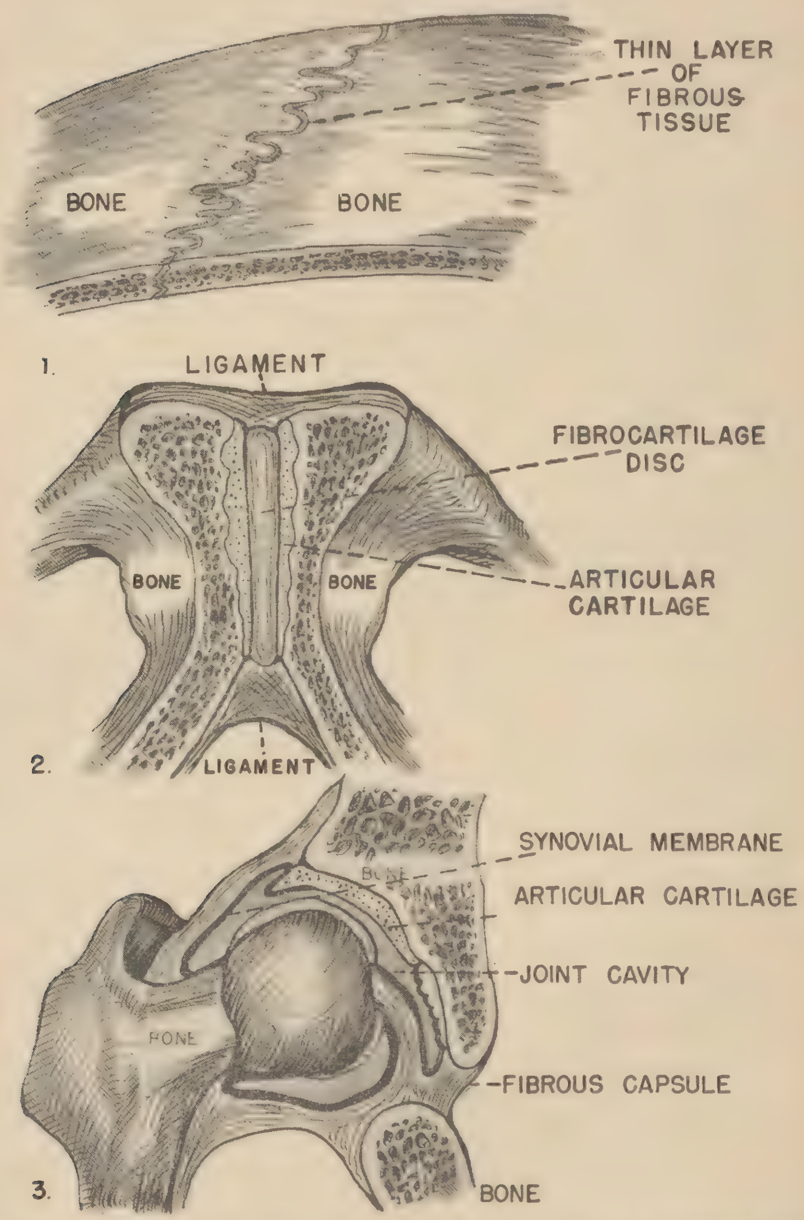


Figure 14. Joints: 1. immovable (articulation of cranial bones); 2. slightly movable (pubic symphysis); 3. freely movable (hip joint).

The points at which bones come together are known as *joints* or *articulations*. These are classified according to the degree of movement they permit. Three general groups are recognized:

Type	*Example*
1. Immovable joints	Bones of the cranium
2. Slightly movable joints	Pubic symphysis
3. Freely movable joints	Knee

The *immovable joints* are articulations between bones which do not provide for motion. The bones in such cases are held together by a thin layer of fibrous tissue or cartilage. In such joints there is usually some interlocking between the two bones. The *slightly movable joints* permit only a limited amount of motion. Between the bones forming such joints there is usually found a fibro-cartilage disc. The bones are held together by ligaments. In the case of the *freely movable joints* the ends of the bones are covered with cartilage. The joint is covered with a fibrous capsule and lined with a synovial membrane. In such joints the articular cartilage serves as a cushion, the synovial membrane produces a fluid which acts as a lubricant, and the fibrous capsule binds the joint together and limits motion. "Water on a joint" is an excess of fluid usually accounted for by either trauma to or infection of the synovial membrane. There are many types of freely movable joints varying in the type of movement they permit. They are classified as follows:

FREELY MOVABLE JOINTS

Type	*Movement*	*Examples*
Arthrodia (Gliding Joint)	Gliding movement only	Articular processes of the vertebrae.
Ginglymus (Hinge Joint)	In one direction (like a hinge)	Elbow joint.
Reciprocal Reception (Saddle Joint)	In two directions	Metacarpal of the thumb with the carpus.
Condyloid	In two directions	Wrist (radio-carpal) joint.
Trochoid (Pivot Joint)	Rotary	Proximal articulation of the radius with the ulna.
Enarthrosis (Ball and Socket)	All directions	Femur with the acetabulum.

MUSCLES

Almost all body activities require some type of movement made possible by the action of muscle tissue. Movement is accomplished by muscle tissue because it has the power to contract or shorten. The body framework (skeleton) is moved by the attached muscles, the heart

pumps blood by means of the contraction and relaxation of muscle, and the food moves through the digestive tract due to the peristaltic action of muscle fibers. This list could be greatly extended but such is unnecessary as the above illustrates the wide variety of physiological activities with which muscular movement is associated.

Muscle tissue comprises about 40 to 50 per cent of the total body weight. It forms a larger portion of the body than any other tissue. The largest portion of this mass is associated with the appendages. Muscle tissue is highly specialized with regard to both structure and function. All muscle tissue possesses the following characteristics: (1) *irritability*, the power of responding to stimuli; (2) *contractility*, the ability to become shorter; (3) *extensibility*, the capacity to stretch; and (4) *elasticity*, power to regain its normal form after stretching. These four characteristics make it possible for muscle tissue to perform a wide variety of functions. There are several types of muscle located in different body areas and possessing different physiological properties. These different types are classified according to their structure, location, and control.

MUSCLE TYPES

Structural type	Location	Control	Action	Function
Striated (skeletal)	Attached to skeleton	Voluntary	Contracts quickly, relaxes promptly.	Moves the bones.
Non-striated (smooth, visceral).	In walls of the visceral organs.	Involuntary	Contracts slowly, maintains tone, relaxes slowly.	Provides changes of shape and movement of internal structures.
Indistinctly striated (cardiac).	In the heart	Involuntary	Contracts and relaxes rhythmically.	Creates pumping action.

Correlation between structure and function can be seen in the above table. One of the distinctive features of skeletal (striated) muscle is that it has an *origin* and an *insertion*. The end of the muscle attached to a relatively stationary bone is the origin and the end attached to a more movable bone is the insertion. The action of any skeletal muscle is to draw the insertion toward the origin, (Figure 15). The skeletal muscles are attached to bones by inelastic tissue, either *tendons* or *aponeuroses*. Near the end of a muscle the amount of connective tissue increases, finally forming a complete cord or band which extends beyond the muscle. Cord-like connective tissue extensions are tendons

and flat band-like extensions are aponeuroses. In contrast to skeletal muscle, visceral muscle does not have an origin and insertion. This type of muscle forms extensive longitudinal and circular interlacements in the walls of the visceral organs. Contraction of the muscles thus creates either a constriction or a flexion in the walls of the organs. Cardiac muscle acts by creating a constriction of the wall of the heart. As the stimulus to contract passes through the heart, the individual fibers respond thus giving rise to a progressive contraction wave.

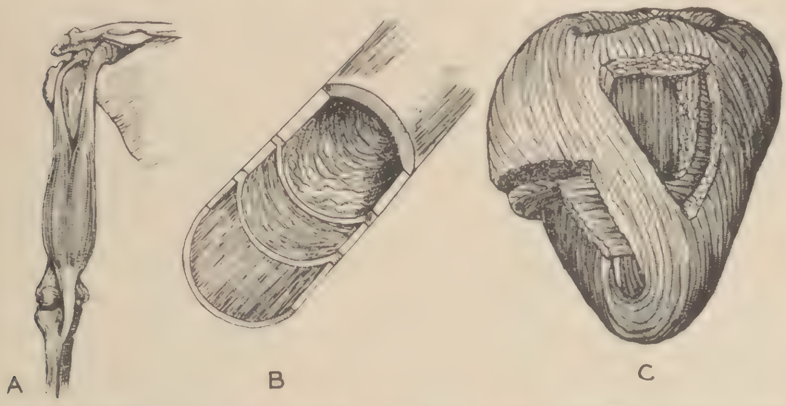


Figure 15. Muscle types: A. typical arrangement of a skeletal muscle (biceps) showing its origin from the scapula and its insertion on the radius; B. arrangement of smooth muscle in intestinal wall showing outer longitudinal muscle fibers and inner circular muscle fibers; C. arrangement of cardiac muscle fibers in the left ventricle of the heart.

Muscles are never in a state of complete relaxation. They are always maintained in a state of partial contraction known as *tonus* (muscle tone). Tonus in the skeletal muscles gives firmness to the body, maintains the posture, and through pressure holds the visceral organs in place. Further, tonus keeps the muscles in a condition whereby contraction will create an immediate movement without having to "take up slack". Tonus varies in different muscles and in individuals. During the period of sleep muscle tone is at a minimum. Tonus is likewise a property of visceral muscle and is particularly important for normal functioning of the stomach and intestine.

An analysis of the response a muscle gives when stimulated shows that the following events occur: (1) there is a period following stimulation during which no change occurs, *the latent period;* (2) the muscle shortens or contracts, the *period of contraction;* and (3) the muscle returns to its original shape, *period of relaxation*. The latent period lasts approximately 0.01 seconds, the period of contraction 0.04 seconds

and the period of relaxation 0.05 seconds. The strength of the contraction will vary depending upon the nature of the overall stimulus and the weight or load on the muscle. It is interesting to note that no volume change occurs in a muscle during contraction. The shortening is accomplished entirely by a change in shape.

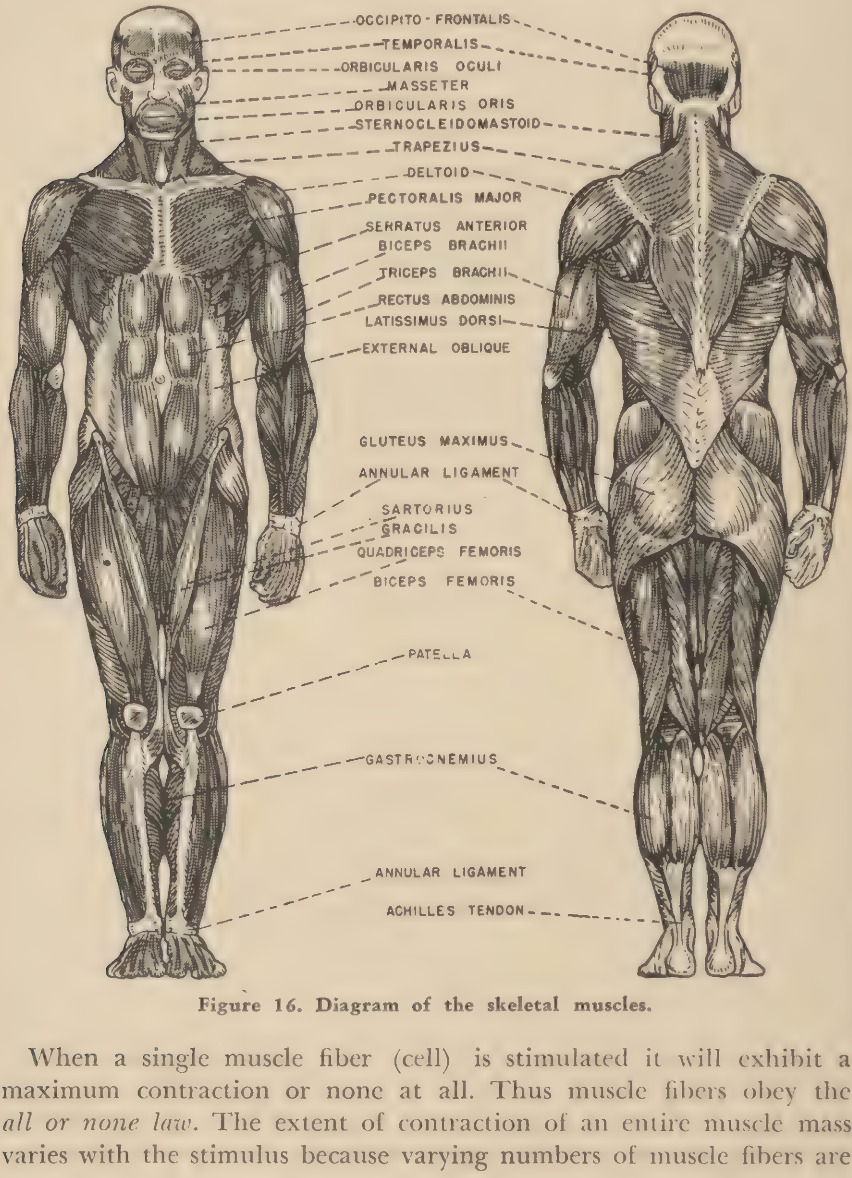


Figure 16. Diagram of the skeletal muscles.

When a single muscle fiber (cell) is stimulated it will exhibit a maximum contraction or none at all. Thus muscle fibers obey the *all or none law*. The extent of contraction of an entire muscle mass varies with the stimulus because varying numbers of muscle fibers are

caused to contract. While such variation is possible in skeletal muscle, it does not occur in cardiac muscle due to differences in structure. The skeletal muscle fibers are insulated from each other by connective tissue. This prevents the transmission of impulses from cell to cell. Cardiac muscle is in the form of a network in which the cells are not insulated from each other thus allowing the spread of impulses.

When muscles are stimulated continuously the strength of contraction decreases progressively until finally no response can be obtained. This progressive decline in efficiency (fatigue) is due to the accumulation of metabolic waste products such as lactic acid and carbon dioxide. With moderate exercise and periods of rest, these products are removed by the circulating blood and the muscle regains its normal condition. Prolonged exercise without periods of rest induces the fatigue condition. The increase in blood flow due to exercise provides a better supply of oxygen and nutrient material to the muscle. This will, up to a certain point, offset fatigue. The products accumulating from fatigue can, to some extent, be removed through gentle massage which works by increasing circulation.

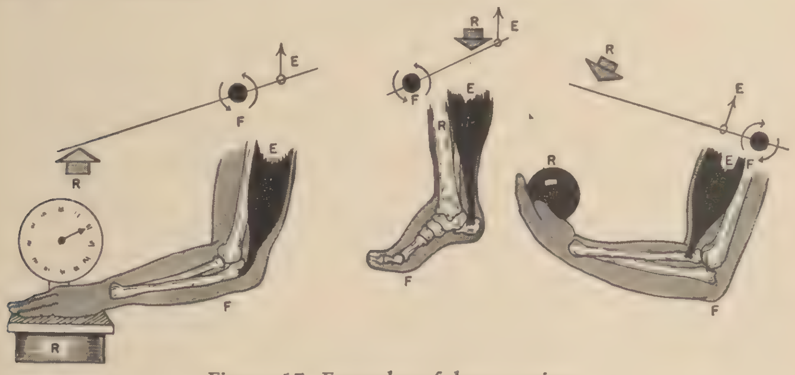


Figure 17. Examples of lever action.

Movement of the body is not accomplished by direct muscular contraction but rather through a system of levers. There are different classes of levers depending upon the location of: (1) the balance point (fulcrum), (2) weight to be moved (resistance), and (3) force necessary for movement (effort). Examples of these types of levers are seen in Figure 17.

During contraction energy is expended and heat is generated. This accounts for the major portion of the heat developed by the body. Not only is heat generated during active exercise, but also during the period of recovery. Heat is constantly being generated in maintaining the partial contraction known as tonus.

BLOOD

Blood is described as a liquid tissue which circulates in the blood vascular system. This means that the intercellular material in which the blood corpuscles are suspended is a fluid, and that this material circulates throughout the body in tube-like structures known as the blood vessels. Blood comprises approximately one-thirteenth of the body weight, or stated in volume, there are about 6 quarts of blood in a normal man weighing 160 pounds.

Blood is composed of two parts, a fluid portion and a cellular portion. The fluid portion is known as the *plasma,* in which is suspended the cellular portion or "formed elements". The formed elements found in the blood are: (1) the red blood corpuscles or erythrocytes, (2) the white blood corpuscles or leucocytes, and (3) the blood platelets. Each of these types have different functions which will be discussed later.

Blood is generally thought of as the transportation system of the body. Such a concept is valid but blood has in addition some other important functions. The following is a list of the major functions ascribed to blood:

FUNCTIONS OF THE BLOOD

1. Transportation of gases, namely, oxygen and carbon-dioxide.
2. Transportation of food, waste, hormones.
3. Equalization of the body temperature.
4. Protection against infection.
5. Maintenance of the acid-base equilibrium.
6. Protection against hemorrhage by clotting.

The plasma or fluid portion comprises approximately 50-60 per cent of the blood based upon volume. This portion of the blood is made up of about 90 per cent water and 10 per cent solid materials. The solid materials which are either dissolved or suspended in the water include such substances as salts, enzymes, hormones, and plasma proteins. The volume of the blood plasma in the body is more or less constant and undergoes only slight temporary variations except under unusual conditions. However, there is some drop in plasma volume due to excessive loss of water through profuse sweating or lowered water intake, and there is a slight temporary rise in plasma volume when the water intake is increased. In cases of extreme dehydration, the plasma volume changes are not only quite varied, but may seriously impair normal body functions.

The plasma serves as a transporting medium for many substances which are either dissolved or suspended in this fluid. Such substances as food and water absorbed from the intestine, hormones from the glands, carbon-dioxide and other wastes from the tissues all enter the blood plasma. These substances are transported to various parts of the body where they can be used, stored or eliminated as the case may be.

Before discussing a second function of plasma, one must have a general understanding of *osmotic pressure*. Osmosis occurs when two liquids containing different amounts of a substance are separated by a membrane which will prevent the migration of that substance, (section A of Figure 18). There will be a movement of the liquid from the side of the low concentration to the side of the high concentration, (section B of Figure 18) until the concentration of the substance in the liquid on both sides of the membrane is equal, (section C of Figure 18). The pressure against which this movement will occur is known as the osmotic pressure. Another way of thinking of this is to consider that the high concentration of the substance has an attraction for the liquid and draws it away from the area of low concentration.

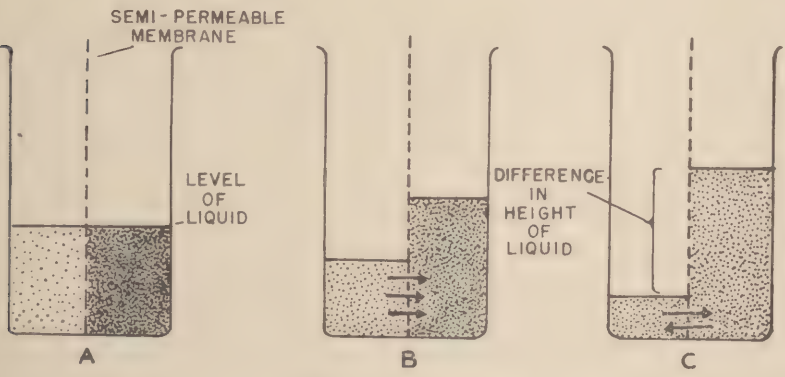


Figure 18. Osmosis: For explanation see text.

A second function of the plasma is to maintain the proper water balance between the blood and the tissue fluids. This is accomplished by: (1) filtration of fluid through the walls of capillaries and (2) osmotic effect of the inorganic salts and the plasma proteins. Inorganic salts are present in the plasma to the extent of approximately 0.9 per cent by weight. This amount of salt creates an osmotic pressure equal

(isotonic) to that of the tissue cells. Thus the water exchange is maintained in a state of equilibrium. The fluid of the plasma, under the mechanical pressure from the heart, filters through the capillary walls into the tissues, resulting in an excess of fluid in the tissues. Subsequently, the plasma proteins which cannot filter through the capillary walls create an osmotic pressure which attracts back into the capillary the water which had been filtered out. Thus there is maintained a constant exchange of fluid between the plasma and the tissues. This serves to carry material to the tissues.

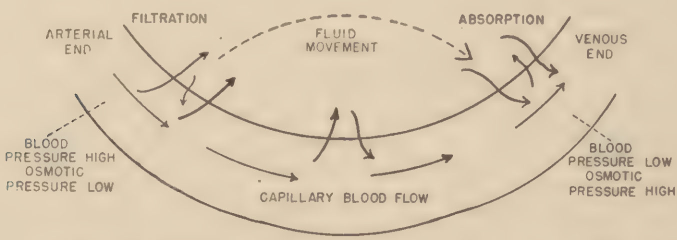


Figure 19. Schematic representation of the movement of fluid in and out of the capillaries.

The plasma volume has proved to be very important in many conditions such as shock, hemorrhage and burns, hence a knowledge of the part played by water, salts and the plasma proteins is extremely valuable.

The red blood corpuscles constitute the most numerous of the formed elements in the blood, their number being between 4,500,000 and 5,500,000 per cubic millimeter of blood under normal conditions. These corpuscles are in the form of biconcave discs which measure about 1/3,200 inch in diameter. The most important chemical compound present in the red corpuscles is hemoglobin, a complex substance composed of a protein (*globin*) plus an iron pigment (*hematin*). Hemoglobin combines readily with oxygen to form *oxyhemoglobin*. This is a highly unstable compound which, in areas containing a low oxygen concentration, readily breaks down and liberates oxygen. This reversible reaction is responsible for the ability of the red blood corpuscles to function as oxygen carriers. For details regarding this process see Figure 27.

One of the interesting characteristics of the erythrocyte is the absence of a nucleus. These corpuscles possess nuclei during their developmental stages but lose them before beginning their functional

life. It is thought that the loss of the nucleus increases the efficiency of these bodies by allowing them to carry more hemoglobin.

The functional life of the erythrocyte is relatively short (10-30 days). New erythrocytes are constantly being produced in the red bone marrow and old ones are being removed from the circulatory system in the liver, spleen, and lymph nodes. Despite the constant formation and destruction, the number of erythrocytes present remains quite constant unless extremely abnormal conditions arise. Some of the causes of a lowered erythrocyte count are:

1. Breakdown of the formation-destruction balance.
2. Mechanical loss of erythrocytes (hemorrhage).
3. Diet lacking sufficient iron.
4. Action of specific toxins which destroy erythrocytes.

The white blood corpuscles (leucocytes) are not as numerous as the red blood corpuscles, normally averaging 7,000 per cubic millimeter. They differ further from the red blood corpuscles in that they are larger in size, do not possess hemoglobin, and a nucleus is always present. There are several different types of white blood corpuscles based upon their structural characteristics and mode of origin. The names of the various types together with their size, per cent present in normal blood, point of origin, and function are seen below. The appearance of the various types can be seen in the frontispiece.

The white blood corpuscles perform two major functions in the body, namely, protection against infectious diseases, and tissue repair. The leucocytes serves as a protection against infectious disease by destroying the invading organisms. Upon the invasion of the body by foreign organisms, the leucocytes are stimulated to collect along the walls of the blood vessels in the region of the tissue damage. Later they migrate through the walls of the blood vessels into the damaged tissues. Within the tissues leucocytes ingest the bacteria and damaged cell fragments by a process spoken of as phagocytosis. While some of these white corpuscles are able to ingest and destroy bacteria, many are themselves killed by the bacterial toxins. The dead white corpuscles together with dead tissue cells, tissue fluids and bacteria form a mass of material commonly known as pus. A second function of the white blood corpuscles is that of tissue repair with the lymphocytes assuming the major role. The exact nature of this mechanism is not understood but it is well established that lymphocytes collect in large numbers where this process is going on and since they do not ingest bacteria, it is assumed that they must have some other role.

COMPARISON OF WHITE BLOOD CORPUSCLES

Name	Diameter in microns	Number per cubic millimeter	Per cent	Point of origin	Function
Lymphocytes	12–15	1,200–3,000	25–33	Lymph nodes	Tissue repair.
Neutrophils	12	3,000–7,000	56–62	Bone marrow	Defense against bacteria.
Eosinophils	12	50–400	1–4	Bone marrow	Uncertain.
Basophils	12	25–50	0–1	Bone marrow	Phagocytosis in severe infection.
Monocytes	14–20	100–600	2–6	Uncertain	Clean up debris.

Normal individuals possess between 5,000 and 9,000 white corpuscles per cubic millimeter of blood. Minor variation within these limits occur under such conditions as physical exercise, exposure to cold, and digestion. Under pathological conditions, however, there are marked elevations in the numbers of white blood corpuscles with the count reaching from 10,000 to 50,000 per cubic millimeter. Such a condition is called a *leucocytosis* and appears in appendicitis, pneumonia, and most other infections. This reaction is defensive in nature and is frequently of great diagnostic value. In addition, there are conditions where in the absence of an infection, the white corpuscle count reaches 500,000 per cubic millimeter as the result of disturbances of the white corpuscle forming elements. This condition is spoken of as *leukemia.* As the result of certain toxic states the white corpuscle count may be reduced to an insignificant figure. A toxic reaction caused by one of the sulfonamide drugs may result in such a lowered count. Certain infections such as typhoid fever and influenza are associated with a moderate lowering of the white corpuscle count. The state of lowered white corpuscle count is known as *leukopenia.*

The blood platelets are round or oval discs approximately one-third the diameter of a red blood corpuscle. These bodies are quite numerous in the blood, ranging from 250,000 to 300,000 per cubic millimeter. Neither their mode of origin nor exact function is clearly understood. It is known however, that they play a part in the clotting reaction of the blood. The lack of information regarding these bodies is due mainly to the fact that they disintegrate upon being exposed to the air.

One of the striking features of blood is the power to form what is known as a clot. This involves a change from the fluid state to that of a soft jelly-like mass which soon becomes firm enough to form a plug that prevents bleeding. This reaction is an essential part of the defense mechanism as it prevents the loss of blood, closes the wound and aids in the healing process.

Normally, blood in the vascular system does not show any tendency to clot, but upon being exposed to the air, blood clots almost immediately except in cases of blood abnormalities such as hemophilia (bleeder's disease). The time required for clot formation varies in individual cases but usually occurs in from 3 to 5 minutes. It is well, however, to remember that the presence of grease and smooth surfaces retards clot formation while rough surfaces tend to hasten clot formation.

The complex chemical mechanism of clotting is beyond the scope of Hospital Corps work but those interested can find a discussion of the subject in any standard text on Physiology.

THE CIRCULATORY SYSTEM

The organs directly associated with the transportation of the blood are the *heart,* the *arteries,* the *veins,* and the *capillaries.* These form a continuous closed tube called the *blood-circulatory system* which reaches to all areas of the body.

The heart is a four chambered muscular pumping organ which supplies the force necessary for the circulation of the blood. The blood vessels which transport blood away from the heart are the arteries. Following the course of the arteries it will be found that these thick walled tubes branch, progressively becoming smaller and smaller. Finally when their bore is little larger than the diameter of a red blood corpuscle and their walls (having become devoid of connective tissue and muscle) are but one cell in thickness, they are known as the *capillaries.* A diagrammatic concept of the size change involved in passing from an artery to a capillary can be obtained from Figure 20.

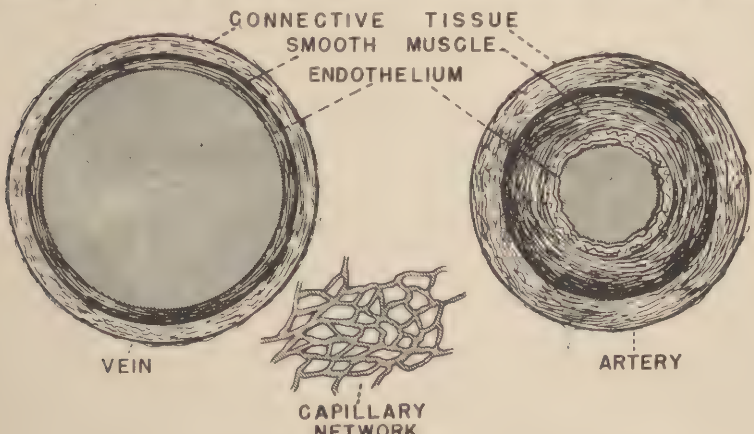


Figure 20. Schematic drawing of artery, vein, and capillary.

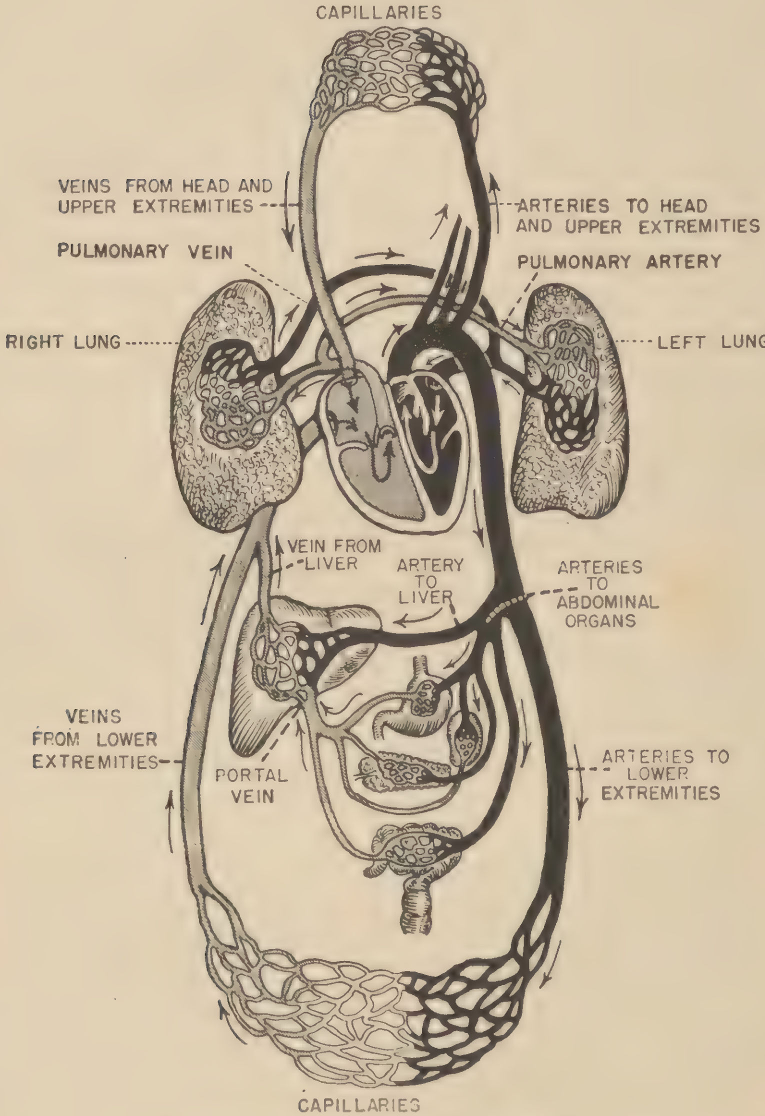


Figure 21. Diagram of the circulation.

The tiny capillaries spread out into the tissues and permit the exchange of materials between the blood and the tissues, the thin-walled condition being of great advantage in effecting filtration, osmosis, and diffusion. The capillaries then begin to unite forming larger and thicker-walled tubes thus giving rise to the *veins* which transport blood back to the heart. The walls of the veins are much thinner than those of the arteries, (see Figure 20). This is due largely to the fact that they possess much less connective tissue and very little muscle. This difference in amount of muscle in veins and arteries has a functional significance accounting for the fact that there is much less active change in the diameter of veins than occurs in the arteries.

The course of the blood circulating through the body may be described as follows: From the left side of the heart to the arteries, to the capillaries, back to the right side of the heart by way of the veins. This is spoken of as the *systemic circulation*. The blood then passes from the right side of the heart to the arteries leading to the lungs, to the capillaries of the lungs, back by way of the veins to the left side of the heart. This is spoken of as the *pulmonary circulation*. Thus it is seen that in making a complete circulatory cycle the blood passes through both the systemic and pulmonary loops. An examination of Figure 21 will show how the four-chambered heart makes this dual loop circulation possible. The time required for the blood to complete the circuit through the entire body is approximately one minute.

The heart is located in the central part of the thoracic cavity between the lungs and toward the front and left. The entire heart is surrounded by a membrane, *the pericardium*, which forms the lining of the *pericardial cavity*, see Figure 8. It will be noted that the heart is more or less conical in shape and is about the size of a closed fist.

The four chambers composing the heart are the *right auricle*, the *right ventricle*, the *left auricle* and the *left ventricle*. It will be seen from Figure 22 that the muscular walls of the ventricles are much thicker than the auricles. This is due to the fact that the ventricles have to furnish sufficient pumping pressure to force the blood through the entire circulatory loop while the auricle has only to force the blood from its chambers to the ventricle. On each side of the heart is a valve system which permits the blood to flow only in one direction. The valves between the auricles and ventricles are the *auriculo-ventricular* valves and those between the ventricles and the arteries are the *semi-lunar* valves. It is important that the valves close accurately, otherwise the efficiency of the pump is lost due to back flow. The course of the blood through the chambers and valves can be seen in Figure 22.

The automatic rhythmical heart muscle movements consist of a wave-like contraction which begins in the auricles and spreads to the ventricles. The contraction is followed by relaxation of the muscles which results in dilation of the heart. During the contraction period (systole) the actual work is done and the dilation period (diastole) is the period of rest.

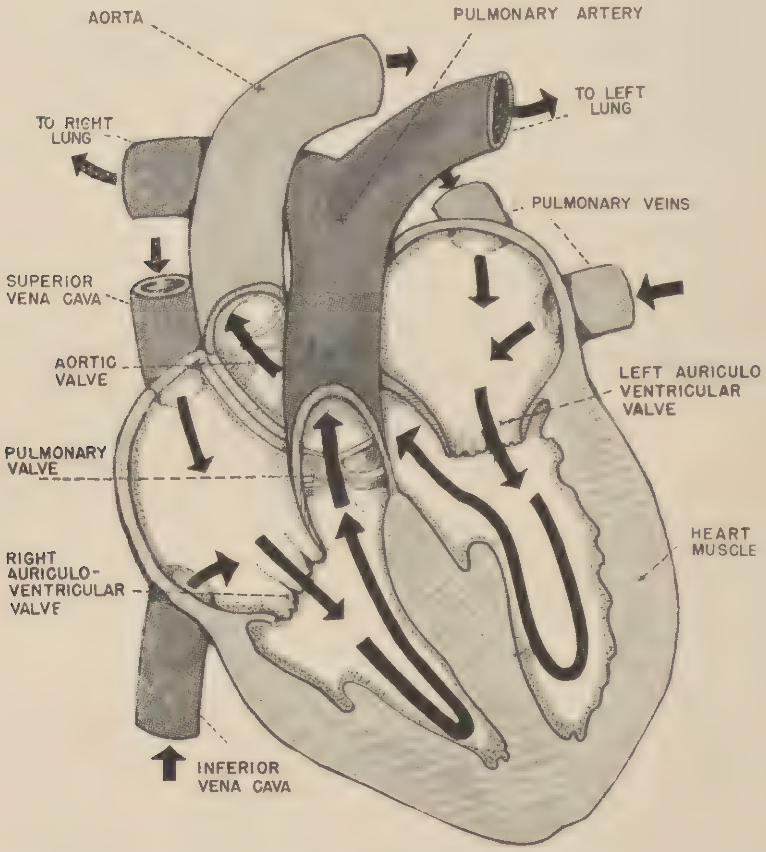


Figure 22. Schematic representation of the flow of blood through the heart.

Regulation of the heart rate is under the control of the central nervous system. A double innervation is employed with a pair of accelerator nerves arising from the spinal cord and a pair of inhibitory nerves arising from the hind-brain (medulla). The course of these nerves can be seen in Figure 42. There are many factors that can change the heart rate, for example the rate may be increased by (1) elevation

in temperature, (2) excess carbon dioxide in the blood, (3) adrenalin, (4) fall of blood pressure, and (5) emotional states. In addition to the change in rate, a definite change in the volume of blood pumped with each beat may also occur. Variations from the normal output of 60 cc. per beat to a maximum output of 150-200 cc. per beat have been recorded. These variations result from the presence of certain chemical substances, such as carbon dioxide which stimulates the heart muscles to produce a stronger contraction. Likewise, variations in the tension on the heart muscle caused by an increased volume of blood in the chambers induces a stronger contraction. Such reactions are adaptive in their nature, providing for situations which require an increased output of blood.

There are two heart disorders, the physiological background of which should be understood by the Hospital Corpsman:

(1) *Obstruction of circulation.* This condition is brought about either by a spasm in the blood vessels supplying the heart muscles, or the plugging of an artery due to a clot (thrombus). In either case the muscles are deprived of oxygen and food material which may result in serious damage or death.

(2) *Leaking heart valves.* Following certain infections such as rheumatic fever, the valves become deformed and this prevents their normal closing. This reduces the efficiency of the heart as a pump by allowing a back-flow on each stroke.

An examination of the blood flow from the heart to the arteries reveals that only during the contraction period (systole) does blood enter the arteries. As each contraction is followed by a relaxation period (diastole) there then occurs a period when no blood is entering the arteries. Thus, the flow of blood in the arteries is intermittent. This fact can readily be observed whenever an artery is cut as the blood escapes in spurts rather than a steady stream. Further, due to the elastic nature of the arterial wall there will be an expansion each time blood is forced in by the heart. This wave of expansion traveling along the artery gives rise to what is known as the *pulse.* The pulse can be felt at many points in the body but is best felt at points where arteries lie adjacent to bone and close to the surface. The strength of the pulse decreases as the distance from the heart increases and as the vessels branch to form smaller vessels. When the blood reaches the capillaries, the pulsating effect has diminished to such an extent that the flow is steady rather than intermittent. The return to normal of the expanded arterial wall during the diastole maintains pressure on the blood so that the intermittent effect is diminished. The flow in the veins like

that in the capillaries, is of the steady rather than the intermittent type. Thus, in cases of damage to blood vessels the character of flow of the escaping blood indicates whether an artery or vein is involved.

Due to the pumping action of the heart, blood enters the arteries under considerable pressure. This pressure is not constant but varies with each heart beat. The maximum force exerted against the walls of the arteries during contraction of the ventricle is the *systolic pressure* and the minimum to which it falls during relaxation is the *diastolic pressure.* The difference between the diastolic and systolic pressure is the *pulse pressure.* Blood pressure is measured in terms of the height of a mercury column necessary to balance the force exerted against the internal blood vessel wall. The normal systolic pressure is 110-135 mm. of mercury (average 120) and the normal diastolic pressure 60-90 mm. of mercury (average 80).

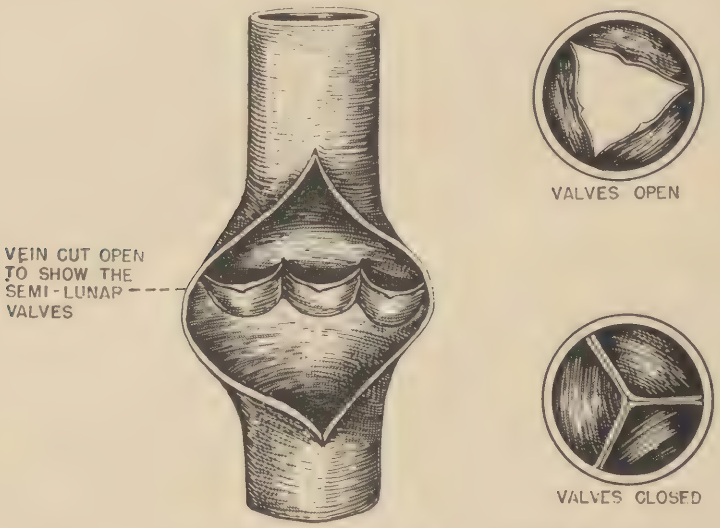


Figure 23. Schematic representation of the valves of the veins.

In the veins the flow is affected by several factors. Movement of the skeletal muscles compresses the veins and forces the blood along. Gravity hinders or aids the flow depending upon the position of the vein in relation to the heart. The presence of valves in the veins (Figure 23) insures that the flow shall be in only one direction. The effect produced by absence of this aid to flow may be seen in cases of "immersion foot" where blood stagnation brought on by muscular inactivity is one of the many contributory factors. The onset of tissue damage can be prevented to a large measure by muscular activity.

The blood supply to any area is partially determined by the bore of the arteries. The greater the diameter of an arteriole the larger will be the volume of blood reaching the area. The diameter of the arterioles does not remain constant but changes due to stimuli from the *vaso-constrictor* nerves. When the latter are activated they cause contraction of the muscles in the arterioles, thus decreasing the diameter and reducing the volume of blood flowing through. When the *vaso-dilator* nerves are activated they allow the muscles to relax, hence the arteriole increases in diameter and volume of blood flowing through is increased. The two sets of nerves which control the diameter of the blood vessels are called the *vaso-motor* nerves. The action of the vaso-motor nerves can readily be obsered in the response elicited by the skin blood vessels to heat and cold. High temperatures stimulate the vaso-dilator nerves resulting in an expansion of the arterioles as evidenced by a reddening of the skin. Cold, on the other hand, stimulates the vaso-constrictor nerves resulting in a decrease in the blood supply as evidenced by a loss of color in the skin.

Some of the common blood vessel disorders are:

(1) *Occlusion.* This is the closing of a vessel due to muscle spasm or a clot. The symptoms depend upon the area in which the occlusion occurs; in all cases there is a loss of blood supply to the affected area.

(2) *Hardening of the arteries* is a degenerative disease of arterial walls and lining, accompanied by loss of elasticity. This condition is usually progressive and results in an inefficient circulation of blood.

(3) *Hypertension* is commonly spoken of as "high blood pressure" because the pressure rises above normal.

(4) *Varicose veins* is an abnormality in which the veins become distended in local areas. The distention frequently is sufficient to cause bleeding from the vessel and poor nutrition of the surrounding area. This condition occurs most frequently in the veins of the legs and the veins of the rectum. Varicose veins of the rectum are called hemorrhoids.

The *lymphatic-circulatory* system is closely related to the blood-circulatory system and has vessels which come from all parts of the body. In many respects the fluid of the lymphatic system resembles blood but it also shows some differences. Two of the major differences are that lymph contains no red corpuscles and contains much less protein than blood.

A striking difference between the blood-circulatory and the lymphatic-circulatory systems is the arrangement of the vessels. The lymphatic system does not have a complete circulatory loop. The lymph vessels originate in the tissue spaces and converge to form progressively larger

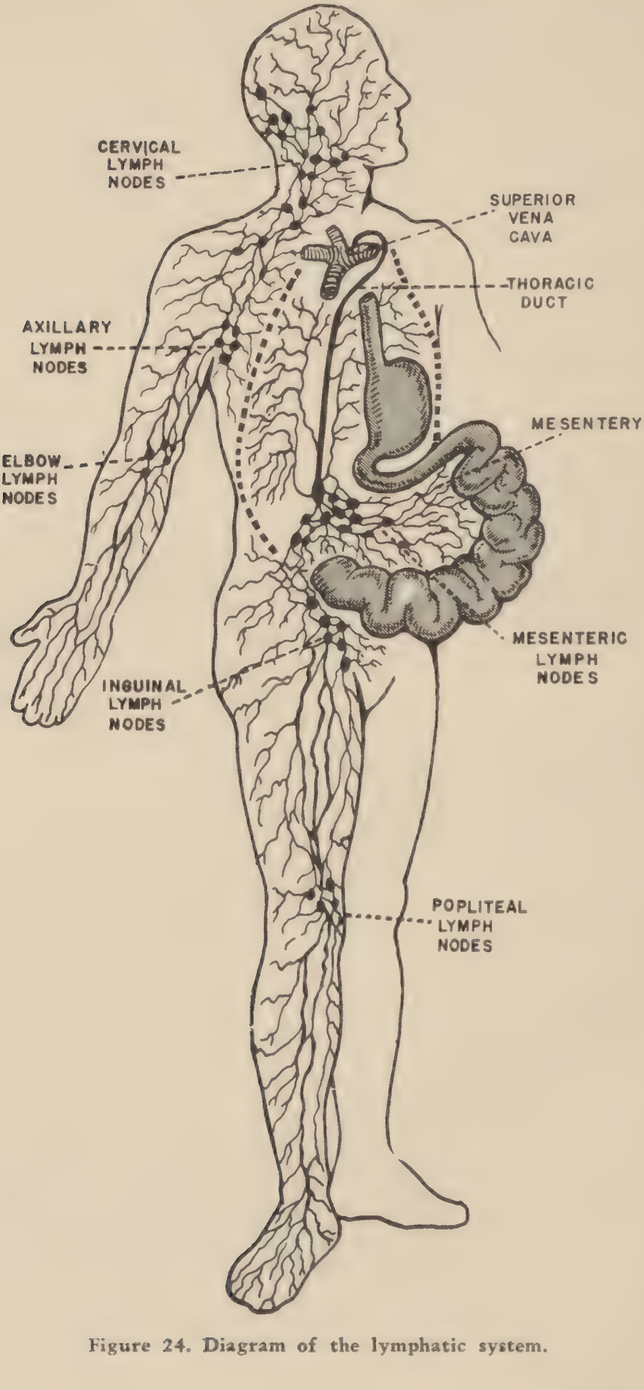


Figure 24. Diagram of the lymphatic system.

vessels which ultimately empty into the blood stream. Along their course these vessels are interrupted by masses of lymphoid tissue known as the *lymph nodes,* (Figure 24). The largest collections of lymph nodes occur in the groin, the axilla, and the neck region.

The circulation of the fluid found in the body is complicated by the fact that throughout the circuit it becomes known as lymph, plasma, and tissue fluid in accordance with its location and consequent composition. The fluid first passes from the lymph vessels into the blood stream. Some filters out of the blood stream through the capillaries into the tissue spaces. From here it either returns to the capillaries or enters the lymphatics, thus completing the circuit. As there is no definite pumping organ, the flow of fluid is slower in the lymphatic system than in the blood-circulatory system. The flow depends upon: (1) compression of the vessels by the skeletal muscles, (2) movement of the diaphragm, and (3) contraction of the intestinal villi which contain numerous terminal lymphatic vessels. Valves in the vessels insure the flow of material in only one direction. The rate of flow varies with the muscular activity of the body.

The lymphatic system performs the following functions: (1) acts as a filter for bacteria and dust particles which are caught and destroyed by phagocytes in the lymph nodes, (2) collects the tissue fluids and (3) transports fats from the intestine to the blood stream. The system doubtless has other functions which are as yet not well understood.

RESPIRATION

The exchange of gases between the body and the environment is a vital activity without which life will not continue. The breathing process is designed to effect this exchange, namely, taking in *oxygen* and eliminating *carbon dioxide.* The organs which constitute the respiratory system are: the nose, mouth, pharynx, larynx, trachea, bronchi, and lungs. The *nose* serves as the normal entrance for air. The walls of the nasal cavity are lined with mucous membrane which warms and moistens the air as it passes through; in addition hairs present serve as a filter removing the dust and dirt. The *mouth* is not the normal entrance to the tract but is used by many persons as such. Mouth breathing is most common among individuals having nasal obstructions such as enlarged adenoids. The *pharynx* serves as an air passage connecting both the nose and mouth with the larynx. The pharyngeal walls possess an abundance of lymphoid tissue which serves to catch and destroy some bacteria entering the tract. The *larynx* is a box-like structure containing tissue folds known as the *vocal cords* which are

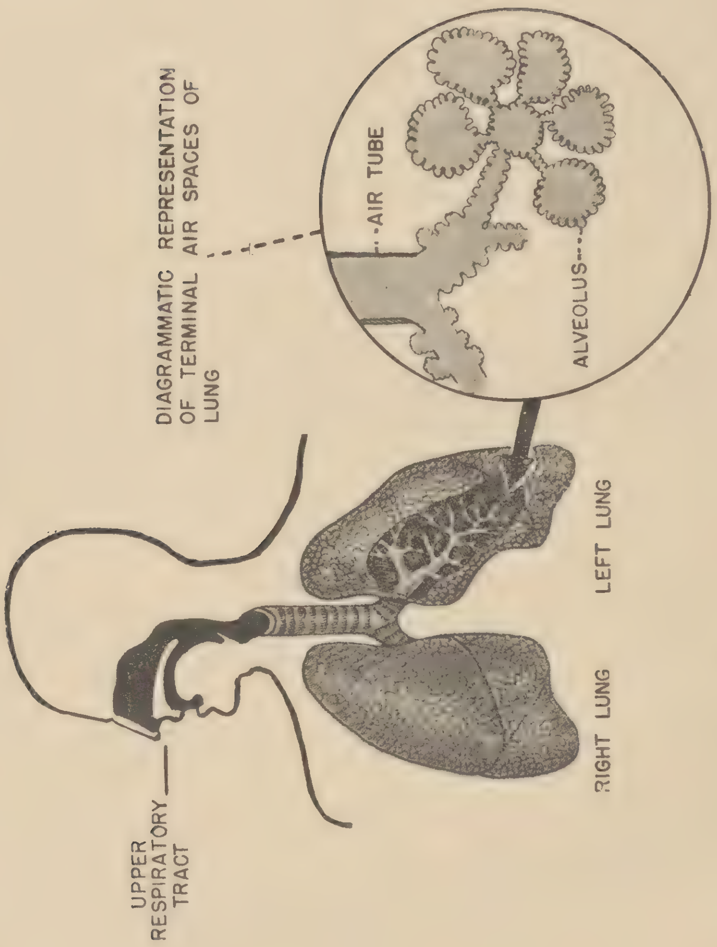


Figure 25. Schematic representation of the respiratory system.

used in sound production. Forcing air against these folds causes them to vibrate thus giving rise to sound. The sound volume will depend upon the force of the expired air striking the vocal cords. By changing the tension on the cords, sounds of different pitch are created. Inflammation thickens the cords changing their period of vibration and creating a "husky voice". Over the upper end of the larynx is a fibrocartilage flap, the *epiglottis*, which together with the constricting action of the pharyngeal muscles close the opening during swallowing thus preventing material from entering the windpipe. Extending down from the larynx is a heavy tube about 4 inches long, known as the *trachea* (windpipe). Imbedded in the walls of the trachea are from 15 to 20 "C" shaped cartilage rings which prevent the tube from collapsing during inspiration. At its lower end the trachea divides to form the *bronchi* one of which enters each lung. Cartilage rings similar to those found in the trachea are present in the bronchi. After entering the lungs the bronchi continue branching, much like a tree, forming smaller and smaller tubes. The smallest tubes are known as the *bronchioles*. These tiny tubes finally end in a cluster of air-sacs, the *alveoli*. The passage of air through the continuous tube from the mouth to the terminal air-sacs can be traced in Figure 25. The lungs are composed of: (1) branching tubes, bronchi and bronchioles, (2) the alveoli, which comprise the major portion of the lung tissue, (3) a dense capillary network which surrounds each alveolus, (4) lymph vessels, (5) nerves, and (6) supporting connective tissue. The lungs are sponge-like in structure with direct air passages leading to the alveoli where the actual gas exchange between the air and blood occurs.

The lungs are located in the thoracic cavity enclosed in a chamber known as the *pleural cavity*. This cavity is divided by the *mediastinal septum* in such a manner that the right and left chambers are completely separated. The lung surface and the walls of the pleural cavity are lined with a serous membrane, the *pleura,* which is smooth and moist so as to allow movement without friction. Inflammation of this membrane (the pleura) is known as pleurisy. Should this condition be associated with adhesions between the pleural surfaces, it may be very painful.

The entire respiratory tract from the nose to the alveoli is lined with mucous membranes which are essentially the same in character throughout. Hence, infection of any part of the tract presents certain similar symptoms; other symptoms indicate alteration in function of the particular part involved. For example, an infection in the nose will be expressed by mucous discharge and partial nasal obstruction while

an infection in the larynx is expressed by mucous discharge and a partial loss of the voice.

The gas exchange between the air and the blood occurs in the lungs; the various parts of the respiratory tract are designed primarily to bring these gases to the site where the exchange occurs. As the lungs are in a cavity, having no opening to the outside, it follows that to increase the cavity size will create a partial vacuum (increase of negative pressure) thus causing the lungs to expand and suck in air. On the other hand, if the cavity is made smaller, negative pressure will be reduced and air will be forced out of the lungs, (Figure 26). The

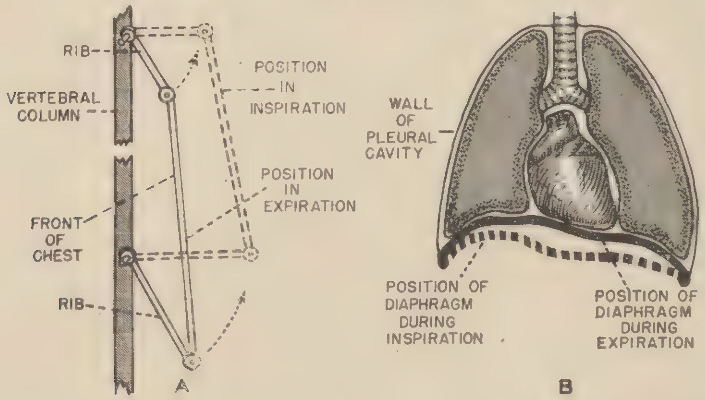


Figure 26. Schematic representation of the movements involved in breathing: A. mechanics of rib movement; B. movement of the diaphragm.

intake of air is called *inspiration* and expulsion of air from the lungs is known as *expiration*. There are two ways by which inspiration is accomplished: (1) the chest muscles raise the ribs so as to increase the dorso-ventral (front to back) dimensions of the pleural cavity, (2) contraction of the diaphragm muscles lowers the bottom of the pleural cavity increasing its vertical dimensions. The former method is referred to as costal breathing and the latter as abdominal. Figure 26 shows what each accomplishes. While the intake of air (inspiration) requires work to expand the chest cavity, the expulsion of air (expiration) is brought about through the elastic nature of the lungs and muscles involved. It should be noted that while normal expiration is accomplished by the elasticity of the lungs and muscles, expiration during physical exercise may be hastened or forced by muscle contraction.

In a normal man at rest there will be from 14 to 18 inspirations and expirations per minute, each bringing about the movement of approximately 500 cc. of air. The air passing in and out with each

normal breathing movement is spoken of as the *tidal air.* After expiration of the tidal air there remains in the lungs approximately 2500 cc. of air.

As the body removes oxygen from the inspired air and gives off carbon dioxide, it follows that the chemical composition of inspired and expired air varies. The extent of this variation can be seen below.

ANALYSIS OF INSPIRED AND EXPIRED AIR

	Inspired	*Expired*	*Change*
	Per Cent	*Per Cent*	*Per Cent*
Nitrogen	79	79	0
Oxygen	20	16	−4
Carbon Dioxide	0.04	4	+4

It will be noted that only 4 per cent of the oxygen has been removed, hence air can be breathed over several times before sufficient oxygen has been removed to render it unfit for use.

The ventilation rate of the lungs is controlled by the respiratory center located in the medulla. This center has nerves running to the muscles associated with breathing, such as *phrenic* nerves to the diaphragm and the *intercostal* nerves to the muscles which raise the ribs. The respiratory center is activated by the concentration of carbon dioxide in the blood passing through it. If the carbon dioxide content is high, the center stimulates the muscles associated with breathing to increased activity and if the carbon dioxide content is low, the respiratory center allows the breathing rate to be retarded. It is interesting to note that diminished oxygen content in the absence of excess carbon dioxide will not bring about an increase in the respiratory rate.

When air containing oxygen enters the alveoli, a situation is created in which air having a high oxygen concentration is separated from blood having a low oxygen concentraion by a membrane which is permeable to oxygen, (Figure 27). The oxygen diffuses through the membrane from the air into the blood. This constitutes the first half of what is known as *external respiration.* Once within the blood, oxygen comes in contact with the hemoglobin of the red corpuscles, which has a strong attraction for free oxygen, and with which it combines to form *oxyhemoglobin.* This compound circulates through the blood vessels until in the capillaries it comes close to the tissues. The tissues have a greater attraction for oxygen than does the hemoglobin; hence the oxygen breaks away and diffuses into the tissues. This is the

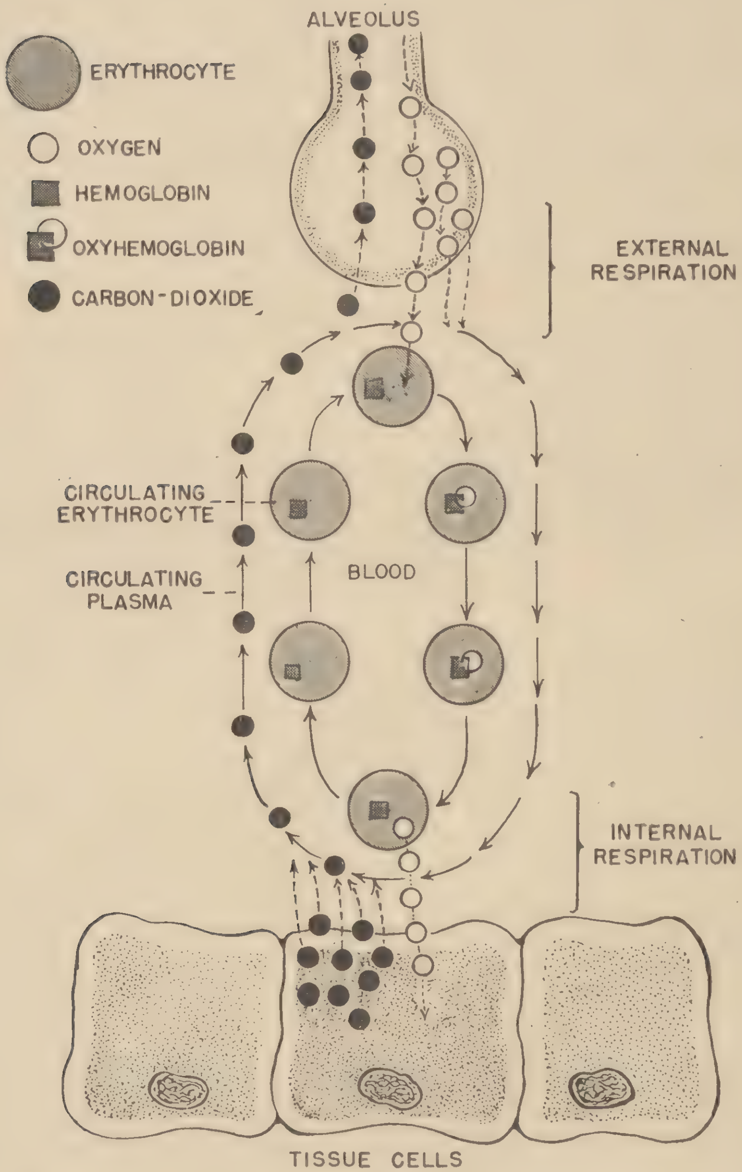


Figure 27. Diagram showing the transportation of gases by the blood.

first half of what is called *internal respiration*, see Figure 27. The hemoglobin thus free of oxygen, continues to circulate until it returns to the lungs where it again combines with oxygen and repeats the process.

The tissues use oxygen in their metabolic activities and in turn develop a high concentration of carbon dioxide. This waste gas diffuses through the capillary walls and becomes dissolved in the plasma. This is the second half of the exchange known as internal respiration. The plasma containing carbon dioxide circulates to the lungs. There the carbon dioxide diffuses out of the plasma through the membranes of the alveoli into the air. This is the second half of the exchange known as external respiration.

The complete respiratory exchange is accomplished by oxygen being transported from the lungs to the tissues in combination with hemoglobin, and carbon dioxide being transported from the tissues to the lungs dissolved in the plasma. This process absolutely must be continuous to maintain the life of the individual and interruption even for a few minutes will have fatal results.

One condition that seriously impairs the respiratory mechanism is carbon monoxide (CO) poisoning which results from breathing exhaust or illuminating gas. The injurious effect is due to the fact that carbon monoxide combines more readily with hemoglobin than does oxygen. Once the hemoglobin makes this combination, it is unable to take on oxygen for transportation. Thus every molecule of hemoglobin combining with carbon monoxide is removed from use in the same sense as if it had been lost from the body. The victim suffers from a lack of oxygen because there is insufficient hemoglobin available for transportation of this essential gas.

Certain accidents (such as drowning, electric shock, and carbon monoxide poisoning) bring about a failure of the breathing mechanism. It is sometimes possible to correct this situation by the use of *artificial respiration* if treatment is started without delay. The more promptly treatment is started the better is the possibility of the victim's recovery. Methods of administering artificial respiration vary, but all are based upon reproducing the pressure changes which normally occur in the chest.

THE DIGESTIVE SYSTEM

The body organs comprising the digestive system are associated with: (1) food intake, (2) physical and chemical modification, (3) absorption, (4) elimination of undigested food. Through this system the body obtains all material from which energy is derived. Further, as the body

is capable of storing sufficient food to last only a short time, normal function of the digestive system is essential. Finally, it is the system best known by the layman, yet remains the one regarding which the greatest amount of misinformation exists.

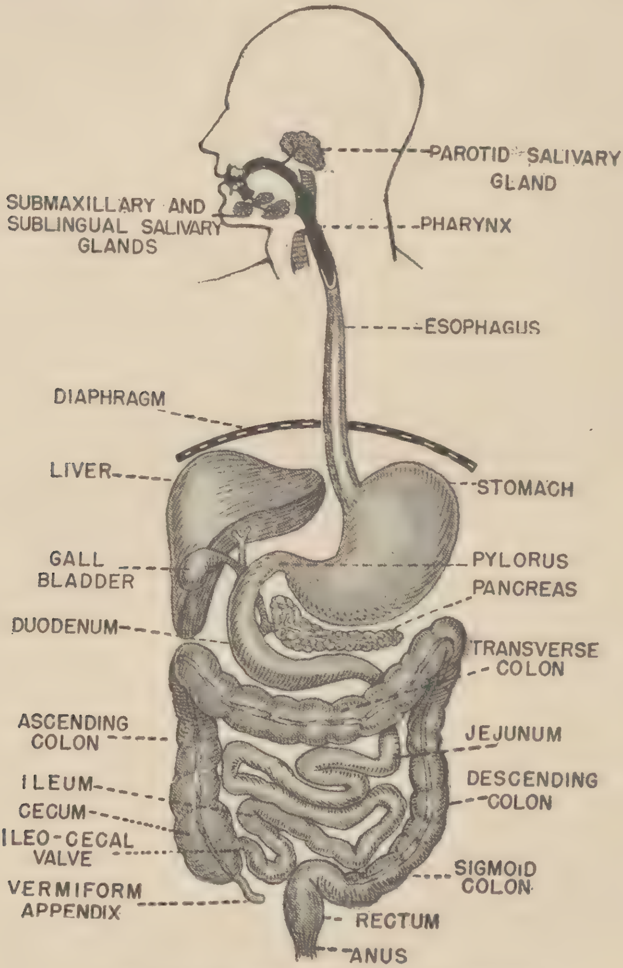


Figure 28. Diagram of the digestive system.

The digestive system is composed of the *alimentary canal* and the *accessory organs.* The alimentary canal forms a continuous tube varying in diameter extending from the mouth to the anus. The organs comprising this tube are the *mouth, pharynx, esophagus, stomach, small intestine,* and *large intestine.* The accessory organs consist of the *teeth, tongue, salivary glands, liver,* and the *pancreas.*

With the exception of the mouth, pharynx, and esophagus the digestive organs lie within the abdominal cavity, (Figure 28). The inner abdominal walls and the outer surfaces of the digestive organs are covered with a smooth membrane, the *peritoneum,* which permits movement without friction. Along the tract are numerous folds in the peritoneum which serves to attach the organs to the posterior body wall thus holding them in place; these folds are known as the *mesenteries,* (Figure 29).

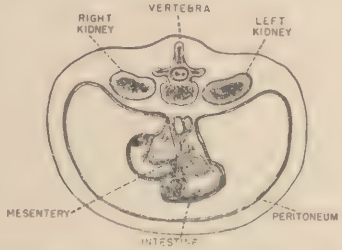


Figure 29. Diagram showing the relationship between the mesentery, peritoneum, and the intestine.

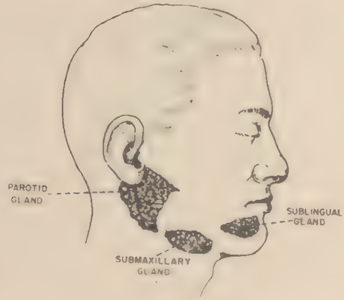


Figure 30. Schematic representation of the salivary glands.

Along the tube forming the alimentary canal there exists considerable variation in structure and function. The *mouth* serves as the entrance for food and connects the exterior with the pharynx. Associated with the mouth are three accessory organs, namely: the tongue, teeth, and salivary glands. The tongue is a muscular organ, attached to the floor of the mouth, which is employed in mixing and tasting the food. The tongue also serves as an aid in vocalization. There are three pairs of salivary glands which pour their secretions into the mouth, these are known as the *parotid, submaxillary,* and *sublingual* glands. The salivary glands are activated under the influence of mechanical (movement of the jaws) and psychological (sight and smell) stimuli. The position of these glands can be seen in Figure 30. Attention is called to the fact

that "mumps" is an infection of the salivary glands with the parotid being the gland most frequently involved. There are 32 teeth present in an adult's mouth, with 16 in both the upper and lower jaw. These teeth vary in shape and are divided as follows: 4 incisors, 2 canines, 4 bicuspids, 6 molars, (Figure 31). While in the mouth the food is: (1) ground by the action of the teeth and tongue, (2) moistened by the saliva, and (3) acted upon by enzymes in the saliva.

The *pharynx* serves as a connection between the mouth and esophagus. So far as digestion is concerned, it functions as a simple transport passage.

Figure 31. Teeth: 1. 2. 3. upper right molars; 4. 5. upper right bicuspids; 6. upper right cuspid; 7. upper right lateral incisor; 8. 9. upper central incisors; 10. upper left lateral incisor; 11. upper left cuspid; 12. 13. upper eft bicuspids; 14. 15. 16. upper left molars; 17. 18. 19. lower left molars; 20. 21. lower left bicuspids; 22. lower left cuspid; 23. lower left lateral incisor; 24. 25. lower central incisors; 26. lower right lateral incisor; 27. lower right cuspid; 28. 29. lower right bicuspids; 30. 31. 32. lower right molars

The *esophagus* is a tube-like structure extending from the pharynx to the stomach. It is located behind (dorsal to) the trachea and heart as it courses through the thoracic to the abdominal cavity. While in the esophagus the food is subjected to the chemical actions started in the mouth. The food mass is divided into small balls (boluses) by localized constrictions in the muscular walls of the tube.

The *stomach* is a hollow muscular organ, about 10 to 11 inches in length and about 4 inches in width, located in the upper part of the abdominal cavity with the major portion left of the mid-line. The shape of the stomach varies with its contents. At the point where the esophagus joins the stomach there is a muscular ring known as the *cardiac sphincter* which opens to admit food and then closes to prevent material from passing back into the esophagus. At the end joining the small intestine is another ring of muscle, the *pyloric sphincter*, which retains the food in the stomach until it is in a semi-liquid condition and then opens to permit passage into the small intestine. The stomach lining contains enormous numbers of gland cells (gastric

glands) which secrete the gastric juice. This fluid composed of hydrochloric acid, mucus, and certain digestive enzymes is responsible for the chemical changes which food undergoes in the stomach. The stomach functions are: (1) to act as a temporary storage sac, retaining the food for one to three hours, (2) to mix the food with the gastric juice until it forms a semi-liquid mass known as *chyme,* and (3) to bring about a chemical change in some foods through the action of enzymes present in the gastric juice.

The *small intestine* is a highly coiled narrow tube about 23 feet long extending from the stomach to the large intestine. Based upon function, this tube is divided into three regions: duodenum, jejunum, and ileum. Throughout its length the tube has a rich supply of blood and lymph vessels which carry away the products of digestion. At the junction of the small and large intestine is a muscular valve, the ileocaecal valve, which prevents material in the large intestine from passing back into the small intestine. The small intestine has two major functions: (1) to bring about chemical changes in the food (digestion), and (2) to pass the digested products to the blood stream (absorption) for distribution throughout the body.

The *large intestine* is a tube of greater diameter than the small intestine and about 5 feet long extending from the ileocaecal valve to the anus. Along its course the large intestine passes up the right side of the abdominal cavity, across to the left, down the left side, makes an "S" shaped turn and passed down to the anus. The functions of the large intestine are: (1) the extraction of water from the food, (2) the addition of mucus to prevent the material in the tube from becoming hard, and (3) the collection of undigested food for elimination from the body.

The *liver,* one of the accessory digestive organs, is a large wedge-shaped glandular structure located in the upper abdominal cavity with its major portion lying to the right of the mid-line. On the anterior portion of the inferior surface is the *gall bladder* which serves as a reservoir for secretions of the liver (*bile*). Running from the gall bladder to the first part of the small intestine (duodenum) is the *bile duct* through which pass the secretions of the liver. The liver has many complex functions, only two of which are important in this discussion, namely: (1) secretion of bile which aids in fat digestion, and (2) storage of sugar in the form of a compound known as *glycogen.*

The *pancreas* is a glandular structure 6 inches long and 1¼ inches wide located in the first turn of the duodenum. This structure secretes the *pancreatic juice* which contains several digestive enzymes. This secretion is transported to the small intestine by way of the *pancreatic*

duct which joins the bile duct just before entering the duodenum. The relationship of the gland and the ducts can be seen in Figure 32. In addition to secreting pancreatic juice this gland functions as a ductless gland, a process which will be discussed later.

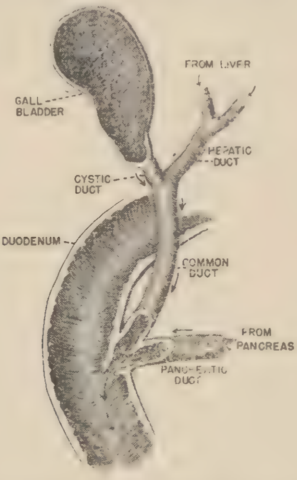


Figure 32. Diagram of bile ducts and gall bladder.

Food material is not in usable form as taken into the body and hence must be changed in its physical and chemical composition by the digestive tract. The physical changes are carried out through grinding action of the teeth and mixing action of the muscles. It is well to note that the muscular contraction waves (peristalsis) move the food along and secondly continue the mixing process throughout the length of the tract. The chemical changes are brought about largely by the action of *enzymes*. These are complex organic substances which tend to hasten reactions involved in changing one chemical compound into another. Enzymes are said to be specific in their action, that is, each food substance is acted upon by a particular enzyme. The major digestive enzymes found in the digestive tract are listed below.

DIGESTIVE ENZYMES

Name	*Secreted by*	*Site of action*	*Action*
Ptyalin	Salivary glands	Mouth	Transformation of starch to sugar.
Pepsin	Gastric glands	Stomach	Partial breakdown of protein.
Amylase	Pancreas	Small intestine	Transformation of starch to sugar.
Lypase	Pancreas	Small intestine	Breakdown of fats.
Trypsin	Pancreas	Small intestine	Partial breakdown of protein.
Erepsin	Intestinal glands	Small intestine	Completion of protein breakdown.

After the various complex food substances have been converted to simple chemical compounds by enzyme action, they are passed from the digestive tract into the blood and lymph. This process is known as absorption and occurs mainly in the small intestine. Certain exceptions are worthy of note, namely, alcohol is absorbed rapidly in the stomach and water is absorbed mainly in the large intestine. The digested products pass into the blood and lymph vessels which transport them to parts of the body to be used immediately or stored for future use.

Probably no organ system presents as many minor upsets as does the digestive tract and, frequently, attempts to "help regulate" the system contribute greatly to further disturbance of this system.

The most commonly encountered gastric upset is "indigestion." This condition is usually brought on by over-eating, although it is frequently the result of indulgence in alcohol or the result of "nervous tension" created by anger, fear, or worry. Many cases of indigestion will correct themselves if left alone and the practice of taking antacids frequently for indigestion is not advised.

Appendicitis is a common and serious digestive disorder arising from an infection of the walls of the appendix. Any digestive upset accompanied by pain in the right iliac region with tenderness and rigidity over Mc Burney's point should be regarded as a suspected appendicitis case. The great danger in such cases is that the appendix wall may rupture and pour bacteria into the peritoneal cavity causing *peritonitis* which frequently results in death. The use of laxatives in suspected cases is extremely bad practice and should always be avoided as increased intestinal movement will frequently cause the appendix to rupture.

THE EXCRETORY SYSTEM

Certain useless end products (waste material) are formed as the result of metabolic activity. Since this waste material is toxic its elimination must not only be a continuous process, but must be taken care of promptly to avoid harmful results. The structures responsible for the elimination of waste are known as the *excretory organs.* The most important of these are the *urinary organs,* but the skin and lungs also play an important role in removing various types of waste from the body.

The organs which make up the urinary system are: the *kidneys,* the *ureters,* the *bladder,* and the *urethra.* These organs serve to eliminate water and certain chemical products resulting from metabolism, and to regulate the blood composition by removing substances which accumulate in amounts above that needed by the body.

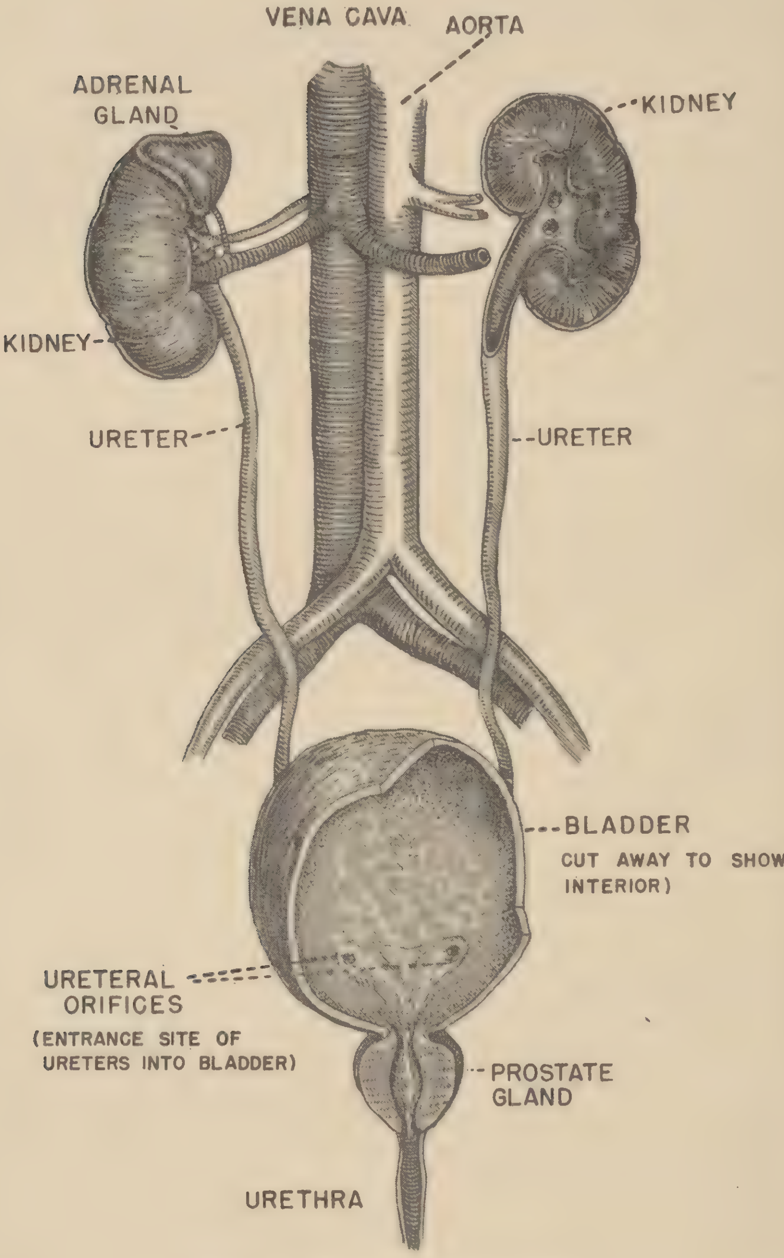


Figure 33. Diagram of urinary system.

The kidneys are located in the back of the abdominal cavity outside the peritoneum. The upper end of each kidney is at the level of the twelfth thoracic vertebra and the lower end about the level of the third lumbar vertebra. Each kidney is roughly "bean shaped" with a distinct depression (the hilum) on the medial surface from which point the ureter arises and the blood vessels enter and emerge. Figure 33 will show the relationship of the blood vessels and ureters to the kidneys.

In its detailed structure the kidney is composed of about a million tiny tubules called *nephrons* which constitute the functional units. At one end of each nephron is a cup-like structure known as "Bowman's capsule" into which runs a tiny arteriole. Next in order is the kidney tubule proper in close contact with which are tiny capillaries. At their terminal ends the tubules join with other tubules to form large collecting tubes which in turn discharge into the pelvis of the kidney. These parts can be located in Figure 34.

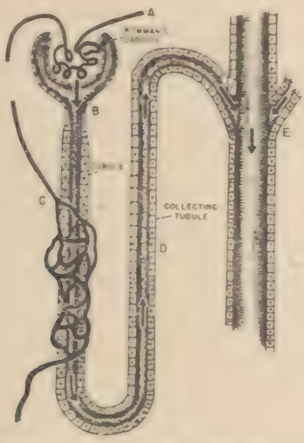


Figure 34. Diagram illustrating the formation of urine. Note: see accompanying text.

There are many theories as to the exact mechanism of kidney function; but in all, the basic elements are the same. Without undue stress on complex details the process of urine formation is as follows: The blood, containing waste products, flows into Bowman's capsule by way of the arteriole (A). As the blood passes through the arteriole a fluid is filtered out which in its composition is very much like plasma without protein. This filtrate passes down into the tubule (B). The cells which form this tubule are selective in their action and reabsorb those substances which the body needs, passing them back to the blood capillary (C), which surrounds the tubule. The useful products are passed back into

the blood and all that remains is waste material which passes to the distal end of the tubule (D), and finally into the collecting tubules (E). The selective action of the cells composing the tubule is the important factor in this mechanism as their action determines: (1) what shall be returned to the blood, thus maintaining the composition of the blood, and (2) what shall be eliminated from the body as urine.

It is important to note the two possibilities where functional breakdown of the nephron can occur. If a break occurs in the membrane forming Bowman's capsule the filtrate which comes through will contain not only water and salts but also the plasma proteins. As the cells of the tubules are unable to return this material to the blood, protein will be found leaving the body in the urine (albuminuria). The second possible point of failure is that the tubule cells lose their selective ability and return either too much or too little of the substances in the filtrate thus failing to maintain the proper blood composition. Of the two possibilities, the former occurs more frequently and is particularly common in individuals suffering from hypertension.

The urine output varies considerably depending upon the water intake, blood pressure, and material to be excreted. All other things being equal, the greater volume of fluids taken in the greater will be the urine output volume. This is merely an expression of the fact that the kidneys maintain a constant blood composition and hence when the water content is above normal the kidneys extract and eliminate the excess. It will be noted that following hemorrhage or shock the urine volume is decreased. This can be explained on the basis that the volume of blood passing through the kidneys has been lowered, hence there is less actual blood taking part in the filtration process. It is likewise found that anything which increases the blood supply to the kidneys will increase the output of urine. Use is made of this principal in pharmacy in administering certain substances when diuretic action (increased urine output) is desired. It is also found that the more dissolved substances to be excreted, the larger will be the volume of water passed along with them; hence the greater will be the urine output. For example, if the salt (sodium chloride) concentration of the blood is raised above normal the kidneys will remove it from the blood and eliminate it. In doing this, water must be employed to dissolve the salt, hence there will be an increased urine output. Practical application of this is seen in cases where sea water is ingested. Instead of quenching thirst, sea water increases thirst due to the fact that the body is being deprived of water which is being used to eliminate the salt.

The normal urine output of an adult individual is approximately 1500 cc. per day and will contain about 60 grams of dissolved substances.

Urea and sodium chloride comprise the major portion of the solid material. Because of the role of the kidneys in controlling the chemical composition of the blood, a study of the urine composition is extremely valuable as an indicator of the metabolic activities taking place in the body. Use is made of urine examination by physicians for diagnostic purposes.

The ureters are thin tubes from 15 to 18 inches long which carry the urine from the kidneys to the bladder. These tubes arise as wide funnel-shaped structures in the region of the depression on the medial surface of the kidney. They narrow rapidly forming a thin tube by the time they reach the level of the inferior end of the kidney and continue this size on down to the bladder. The ureters enter the lower portion of the bladder and pass through its wall at such an angle that distention of the bladder will pinch the tube closed and prevent urine from backing up into the kidneys. These tubes function only as simple transport tubes for the urine.

The bladder, a sac-like structure located in the lower abdominal cavity just posterior to the pubis, serves as a temporary reservoir for the urine. The volume of the bladder is normally about one pint. The passage of urine out of the bladder (*micturition*) is a voluntary process except in abnormal cases. Leading from the bladder to the exterior is a tube known as the urethra. In the male this tube passes through the *prostate gland* and through the *penis* opening to the outside by way of the *urinary meatus*. In addition to transporting urine, the male urethra serves to transport the reproductive products. In the male certain abnormalities may cause a blocking of the urethra and prevent the passage of urine. Most common among such conditions are: (1) enlargement (hypertrophy) of the prostate gland, and (2) strictures resulting from infections of the urethra. The retention of urine is quite painful and may produce serious results if not relieved.

THE NERVOUS SYSTEM

The regulation and coordination of various body activities are brought about by several means, the best known and most rapid of which is the *nervous system*. For purposes of classification the nervous system is divided into the following parts: (1) the *central nervous system* consisting of the brain and spinal cord, and (2) the *peripheral nervous system* which consists of nerve fibers connecting the higher centers with the body wall and visceral organs. The gross plan of the nervous system can be seen in Figure 36.

The entire nervous system is composed of specialized cells, the *neurones.* These cells are made up of a *cell body* from which arise fiber-like projections known as *dendrites* and a single *axon,* (Figure 35). While the dendrites are usually short fibers, the axon may reach a

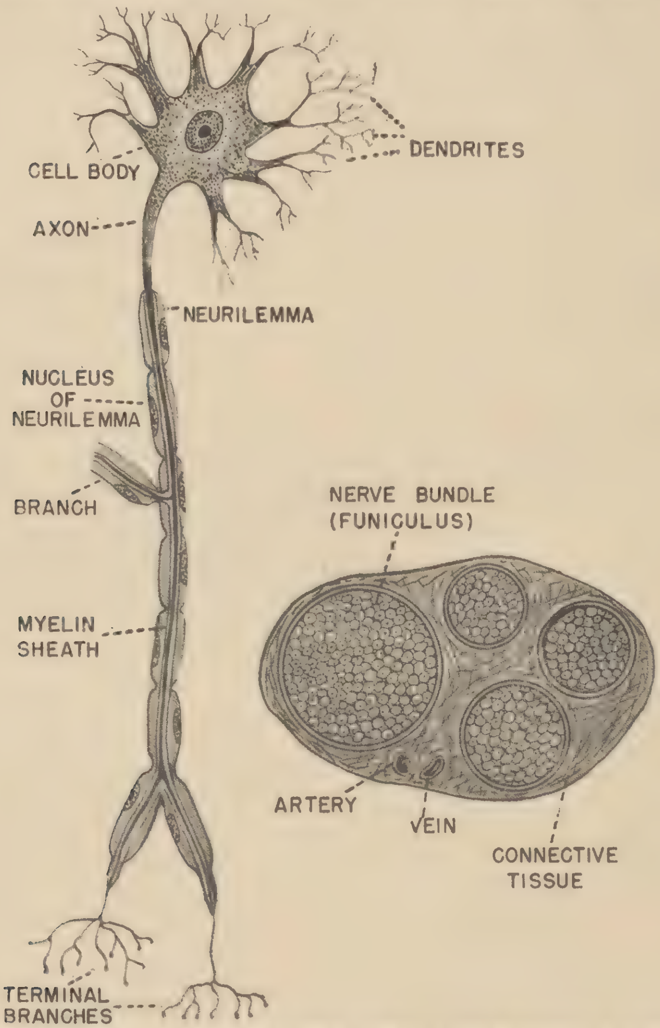


Figure 35. Diagram of a typical nerve cell and a cross section of a nerve.

length of three feet. The axon is composed of a *central core* (axis cylinder) and usually one or two surrounding sheaths. The surrounding sheaths are the *myelin* and *neurilemma,* (Figure 35). Myelin is a white fatty substance which serves as an insulator for the nerve fiber. Myeli-

nated nerve fibers are a waxy white color and the non-myelinated are grey. The neurilemma sheath is protective and plays an important role in the regeneration of nerve fibers following injury. When a nerve fiber is cut the part severed from the cell body will degenerate, the part

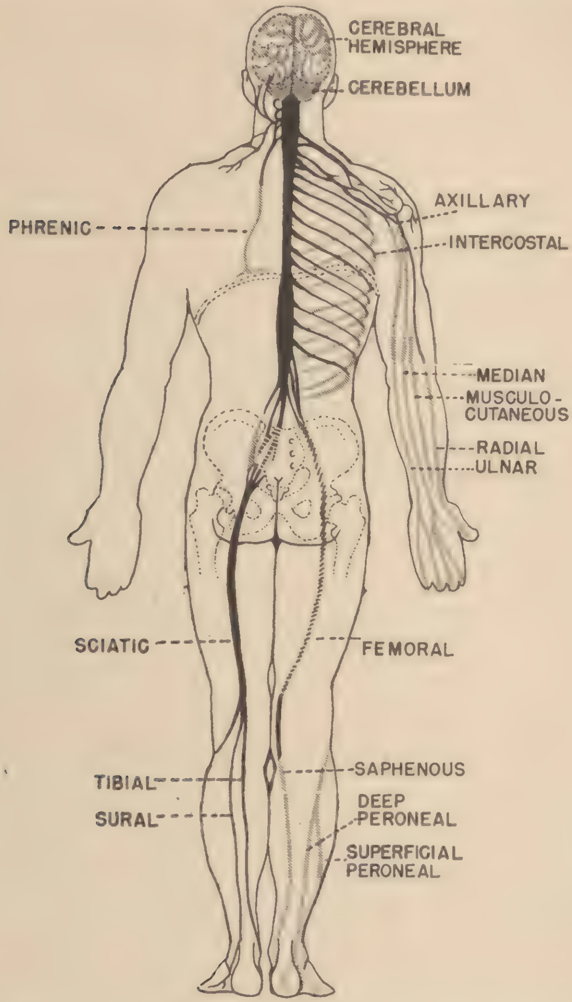


Figure 36. Schematic diagram of the nervous system.

attached to the cell body may regenerate under the influence of the neurilemma. These cells show marked powers of irritability and conductivity or stated otherwise they receive nerve impulses and transmit them to other cells. Transmission is always in one direction, namely,

from the dendrites to the cell body and by the axon, away from the cell body. The passage of a nerve impulse usually involves two or more neurones and the junction between neurones is known as the *synapse.* The exact nature of this connection between neurones is unknown.

Neurones are classified according to their function hence there are: (1) *sensory neurones,* and (2) *motor neurones.* Sensory neurones are those which transmit impulses to the central nervous system. At the distal end of a sensory neurone chain will be found a *sensory receptor,* such as the receptors of touch, taste, or temperature. Motor neurones are those which transmit impulses from the central nervous system to muscles and glands. At the end of each motor neurone chain will be found a *motor end-organ* which passes the stimulus to muscles or glands bringing about their activation.

Many nerve fibers surrounded by a sheath form a funiculus. A nerve is composed of one or more funiculi bound together by connective tissue. Nerves receive their blood supply from vessels which run parallel to the fibers and penetrate the connective tissue cover. The major portion of a nerve is composed of non-nervous tissue including connective tissue, blood and myelin. Throughout their course, nerves branch and fuse with other branches yet each individual fiber remains distinct. Most nerves contain both sensory and motor fibers and are known as *mixed nerves.* Injury to a nerve may prevent the transmission of impulses connecting body areas distal to the injured region. Nerves will, in some cases, regenerate and restore normal transmission pathways. To effect recovery exposed or damaged nerves must be handled with the greatest of care, otherwise the injury may become permanent.

The simplest form of reaction theoretically possible is brought about by the *reflex arc.* A simple reflex arc involves: (1) a receptor, (2) a sensory neurone, (3) a connecting neurone in the spinal cord, (4) a motor nurone, and (5) a motor end organ, (Figure 37). The receptor receives a stimulus, transforms it into a nerve impulse, and passes it to a sensory neurone. The impulse travels along the sensory neurone to the spinal cord where connection is made with a motor neurone. The impulse for activation then travels out over the motor neurone to the motor end organ which in turn activates a muscle or gland. An example of reflex action is seen when the finger is withdrawn after touching a hot object. In this case the temperature receptors of the skin are stimulated to start a nerve impulse in over a sensory neurone to the spinal cord. Connection is made with a motor neurone which in turn activates the muscles of the arm to contract, thus removing the hand from the source of the stimulus, (Figure 38). It is doubtful whether

such a simple reflex would be established in the human body for many receptors would be stimulated and many motor neurones would be involved in bringing about the necessary activation. Reflex connections involving several sensory and motor neurones are shown in Figure 37 A, B, and C.

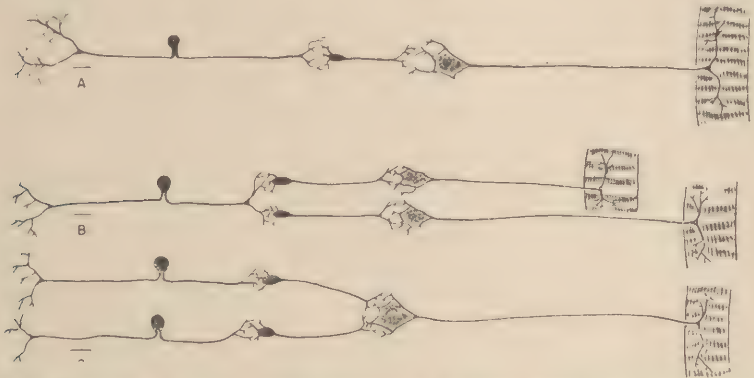


Figure 37. Diagram of some possible connections between sensory and motor neurones in forming reflex arcs: A. a single sensory neurone connecting directly with a single motor neurone; B. a single sensory neurone connecting with two motor neurones; C. two sensory neurones connecting with one motor neurone by two intermediate neurones.

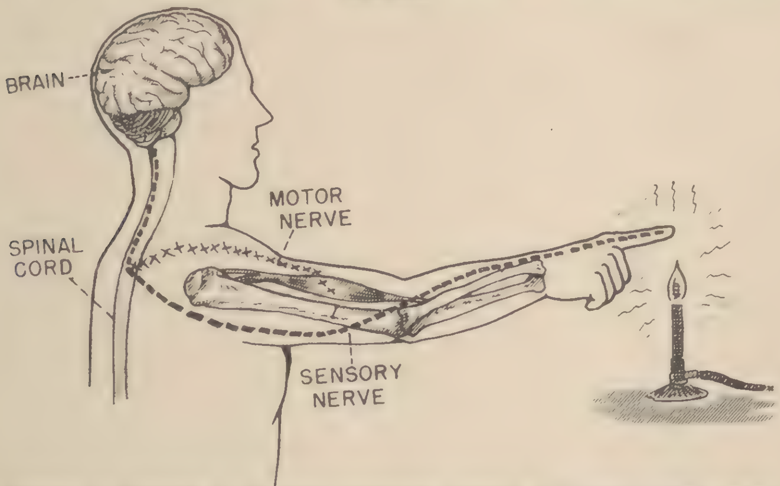


Figure 38. Diagram of the nerve pathways involved in a simple spinal reflex.

Reflex acts are classified according to the complexity of the reaction and usually fall into three groups:

(1) *First level reactions,* those involving a sensory neurone, a motor neurone, and a connecting neurone in the spinal cord. Acts of this level are involuntary.

(2) *Second level reactions,* involve the neurones of first level reactions, but in addition connection is made to the lower centers of the brain. These acts are involuntary but involve the coordination of large numbers of structures.

(3) *Third level reactions,* include the connections made on the second level but in addition the impulse passes to the higher centers of the brain so that one becomes conscious of the act.

The brain is a large mass of nerve tissue, weighing approximately 48 ounces. It is located inside of the skull in what is known as the cranial cavity. As this organ is extremely delicate and injuries to it would impair the function of parts, if not the entire body, the protection offered by the bones of the skull is essential. For further protection the brain is enclosed in three membranes known collectively as the *meninges.* These membranes together with the *cerebrospinal* fluid between them form a cushion separating the brain and the bones of the skull.

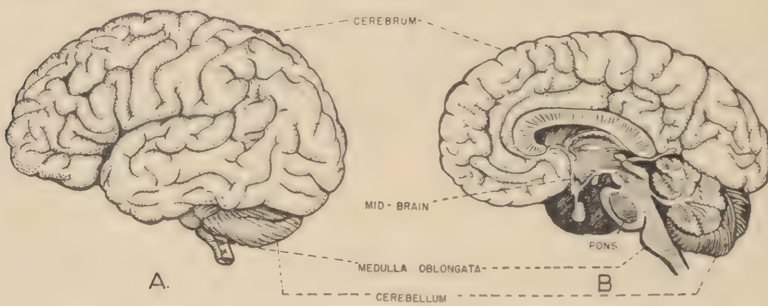


Figure 39. The brain: A. lateral view; B. median sagittal view.

The *brain* is divided into five parts; the *cerebrum* (fore-brain), *mid-brain, pons, cerebellum* and the *medulla oblongata* (the latter three constitute the hind-brain), (Figure 39). Each division can be recognized by its characteristic structure and each has a particular function.

The *cerebrum* constitutes the largest portion of the brain, forming the entire top and sides. The surface is marked with furrows and ridges which serve to increase the surface area. These surface elevations, spoken of as convolutions, give the brain a characteristic appearance. The deep furrows (fissures) divide the surface of the cerebrum into five regions or lobes: (1) the frontal lobe, (2) parietal lobe, (3) temporal lobe, (4) occipital lobe, and (5) the island of Reil. All of these lobes are easily distinguished except the last which cannot be seen from the surface. As the cerebrum is the part of the brain controlling our higher mental activities such as memory, consciousness and voluntary move-

ment, considerable study has been conducted on the functional role of localized areas. The location of centers for various sensory and motor activities is now well understood. Figure 40 shows the areas where known functional centers are located. The *mid-brain* serves as a connecting pathway from the lower areas of the brain to the cerebrum. The *pons* is a connecting pathway between the right and left halves of the cerebellum and also between the medulla and the cerebrum. The *cerebellum*

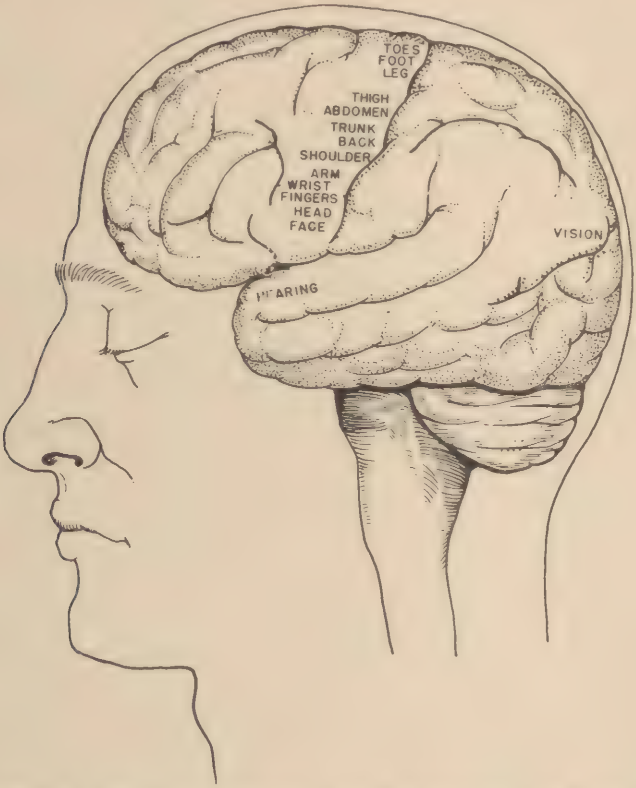


Figure 40. Diagram of the cerebral cortex showing the location of certain functional areas.

is the lower posterior area of the brain between the occipital lobe and the pons. This section can be identified by the numerous furrows on the surface. The function of the cerebrum is to control equilibrium, muscle tone, and muscle coordination. Injuries to this region result in a lack of ability to control muscular movement. The *medulla oblongata* is the most posterior part of the brain and is continuous with the spinal cord. The medulla serves as a connection between the cord and

the higher centers of the brain. It also contains the cardiac inhibitory center which keeps a check on the heart rate, the vasomotor center which regulates the diameter of the blood vessels, and the respiratory center which regulates the breathing rate.

Because of its high metabolic rate it is necessary for the brain to receive a rich supply of oxygen. This is provided for mainly by branches of the internal carotid and vertebral arteries which carry freshly aerated blood to the brain. Failure of the brain to obtain an adequate blood supply even for a few minutes produces unconsciousness. The higher brain centers are apparently more sensitive to an inadequate oxygen supply than are the lower centers. Part of the serious effects of shock are due to a failure of the brain to receive its proper blood supply. Other conditions, such as fainting, have a similar cause.

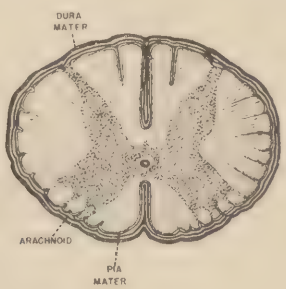


Figure 41. The spinal meninges; a cross section of the spinal cord.

The *spinal cord* consists of nerve cells and bundles of fibers running caudally from the hind-brain (medulla) to the level of the second lumbar vertebra. The entire cord is protected by being enclosed in the spinal canal of the vertebrae. The cord is further protected by the surrounding meninges, (Figure 41). Along the spinal cord there are thirty-one pairs of spinal nerves which connect the cord with the muscles, viscera, and glands. It is by way of these spinal nerves that the cord communicates with various parts of the body. The cord serves as a center for reflex actions with each section of the cord being responsible for activities at a different level of the body. The cord also serves as a communicating pathway to and from the brain. Injuries to the cord may interrupt communication between the brain and parts of the body distal to the injured area. Such interruption may result in partial or complete paralysis.

The *autonomic nervous system* is that part of the peripheral system which controls the activities of all visceral muscle, the heart, and the glands. One of the distinguishing features of this system is the auto-

matic nature of its action. For example, it regulates the diameter of the blood vessels, the movements of the alimentary tract, and the secretion of the glands without the person's awareness that such events are taking place. Each of the visceral organs has two types of autonomic

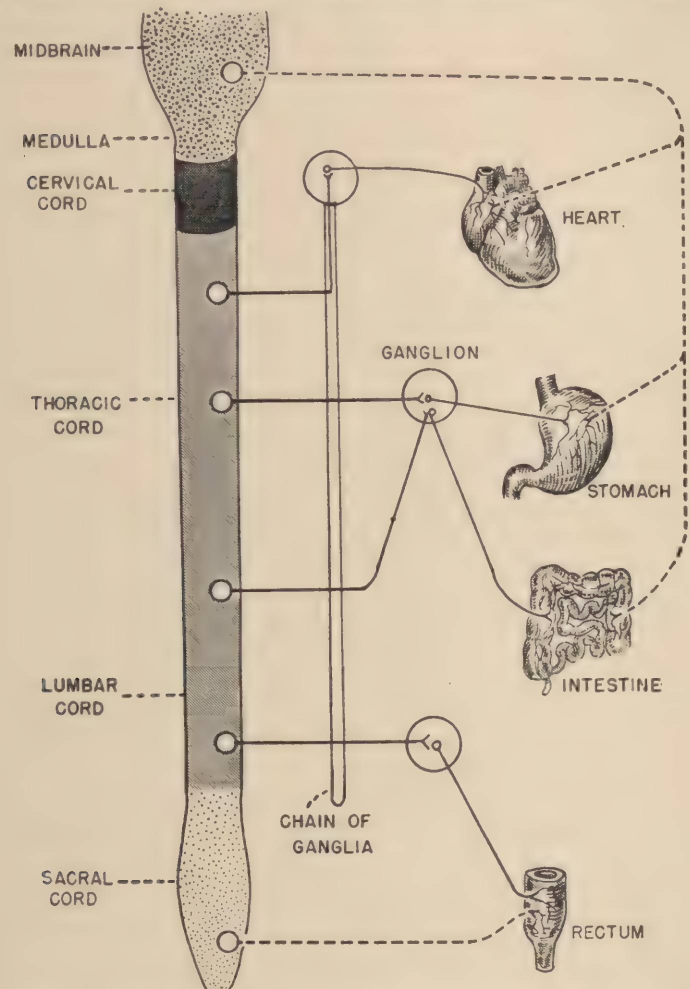


Figure 42. Schematic representation of the autonomic nervous system.

nerve fibers running to it, (Figure 42). One of these fibers has its origin in the thoracic or lumbar region of the spinal cord (thoracolumbar system) and the other fiber has its origin in the mid-brain, medulla or sacral region (craniosacral system). The two fibers which run to any organ are antagonistic in their action. One of the fibers is *excitatory*

and the other *inhibitory*. The action of the organ involved will then be the result of a balance between the two stimuli. Many examples could be presented to show the antagonistic action of the two systems but the following will suffice:

REACTIONS OF THE AUTONOMIC NERVOUS SYSTEM

Craniosacral System	*Thoracolumbar System*
Slowing of heart beat	Acceleration of heart beat
Contraction of bladder muscles	Relaxation of bladder muscles
Constriction of iris	Dilation of iris

In cases of individuals subjected to excitement or fear, the autonomic nervous system plays an extremely important role. Under the influence of fear the system so regulates the body activities that the individual will be at maximum efficiency to meet the situation. This change in body activities will doubtless occur before the individual realizes it and many times before he is aware that he fears something. The autonomic system brings about such well known normal reactions to fear as: the increase in heart rate, constriction of the blood vessels, inhibition of stomach movements, and a rise in blood sugar. Greater excitement may bring forth stronger stimulations resulting in such actions as vomiting and defecation. When stimuli such as fear persist for long periods of time, the body functions may be so altered as to present a picture of physical illness. In such cases there is no actual physical injury but simply an alteration in the level of activity. Cases of this type involving the stomach and heart are quite common. Emotional upsets of this type unless checked may lead to permanent abnormalities of function.

A condition of fatigue in the neurones can be induced by either mental or physical work. Fatigue expresses itself as an increased resistance to the passage of nerve impulses across the synapse. In its mild form this either makes the individual slow in his reactions (mental dullness) or if inhibitions are suppressed the individual may become hyperexcitable. In the latter case minor problems such as noise and movement become greatly exaggerated. If, however, the conditions inducing fatigue continue for long periods of time such abnormal mental states as neurasthenia and nervous collapse may possibly develop. It is well for the Hospital Corpsman to bear in mind the conditions which bring on fatigue in order to reduce its occurrence among his crew. One of the outstanding fatigue factors is pain or any physical discomfort, other contributing factors are poor health, worry, fear, and work done against one's will. As all of these conditions may be encountered aboard ship, corrective measures must be instituted to prevent the onset of fatigue if the crew is to be maintained in a healthy, efficient condition.

SPECIAL SENSE ORGANS

One is usually taught that there are five senses, namely, vision, hearing, taste, smell, and touch. A closer consideration of the subject reveals that temperature sense, pain, balance, hunger, thirst, and muscle and joint sense may be added to the original list.

VISION

The organs which make vision possible are the eyes together with their associated structures, the optic nerves, and the optic center of the brain. The eyes are located in the orbital cavities which provide these delicate organs protection from physical injury. In addition, there is the lacrimal apparatus which produces tears to moisten the surface and wash away foreign matter. The tears, except when present in excessive quantities, drain into the nose through a tube known as the *lacrimal duct*. This duct has its origin at the inner angle of the eye on the upper and lower lids. The eyelids serve to prevent the entrance of foreign objects. The conjunctiva is the mucous membrane which lines the eyelids and covers the anterior surface of the eyeball up to the edge of the cornea.

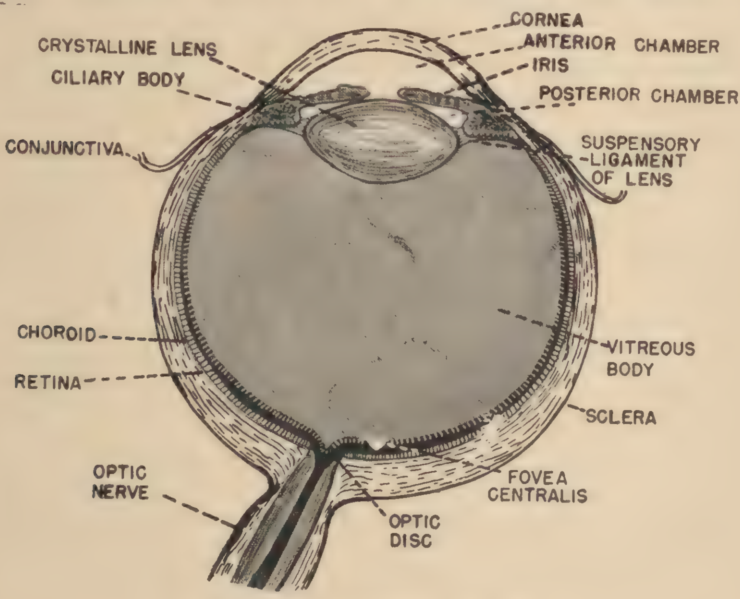


Figure 43. Diagram of the eye.

The eyeball is spherical in shape with an outer wall composed of three layers: the *sclera,* the *choroid*, and the *retina,* see Figure 43.

The sclera is the tough outer cover of the eye. In the front it is modified to form the transparent *cornea* through which the rays of light enter the eye. The cornea is extremely thin and is easily injured. Healing of the cornea takes place readily and usually does not impair the vision. When the deeper layers of the cornea are injured, opaque scars are produced which seriously impair vision if they are in the line of sight. The choroid is the vascular layer and also contains the pigment of the eye. In the front this layer is modified to form the *iris* which provides a curtain to regulate the amount of light entering the opening known as the pupil. The retina is the innermost layer and contains the light-sensitive bodies known as *rods* and *cones*.

In the front part of the eye, just behind the iris, is suspended the *crystalline lens* which bends the light rays in such a manner as to bring them to focus on the retina. The lens is held in place by the ciliary muscle. This is attached to the border of the lens in such a manner that changes in tension of the muscle will change the shape of the lens and thus vary its focus as the case may require. In front of the lens is a small chamber filled with watery fluid known as the *aqueous humor* and behind the lens is a large chamber filled with a jelly-like material known as the *vitreous humor*.

The *iris* forms a pigmented curtain which regulates the amount of light entering the eye. This is accomplished by varying the size of the opening in the iris known as the *pupil*. If there is a small amount of light present the muscle of the iris allows an expansion in the diameter of the pupil to admit as much light as possible. If the light is bright, the diameter of the pupil is decreased to exclude the excess light. Change in the size of the pupils in response to light is spoken of as the *pupillary reflex*. This is of diagnostic value in certain cases of brain injury.

In general one may compare the eye with an ordinary camera, as both possess: (1) an opening through which light in varying amounts can be admitted, (2) a lens which brings the light rays to a focal point, and (3) a sensitive area which records the image.

Without a lens the eye would be able to distinguish between light and dark but could not determine the shape of objects. The vision of objects is made possible because the lens so bends the light rays as to cause an image to be formed on the retina. Changes in the shape of the lens make it possible to see objects close to the eye or objects at a great distance. In viewing objects close to the eye the ciliary muscle relaxes and allows the lens to bulge due to its elasticity. In this position the lens will focus on the retina images of objects only a few inches from

the eye. For objects in the distance the ciliary muscle creates a tension on the lens which will flatten it out, changing the focus so that images of these objects will be projected upon the retina. The ability of the lens to change shape decreases with age because of loss of elasticity, hence older persons frequently require the use of artificial lenses to correct for near vision. Changes in the shape of the eye frequently cause difficulty in focusing. Such conditions can usually be corrected by the use of lenses (glasses). Some examples of such corrective measures are seen in Figure 44.

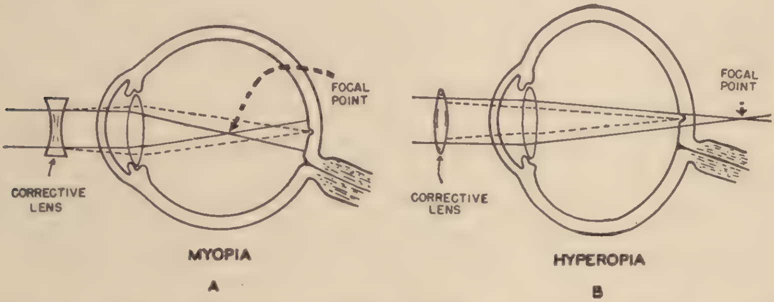


Figure 44. Diagram showing the corrective action of artificial lenses: A. The uncorrected light rays (solid line) come to a focal point in front of the retina (myopia) and the insertion of the concave lens causes the corrected light rays (broken line) to converge to a focal point on the retina; B. The uncorrected light rays (solid line) come to a focal point in back of the retina (hyperopia) and the insertion of the convex lens causes the corrected light rays (broken line) to converge to a focal point on the retina.

The reception of light impressions is made possible by the presence of the *rods* and *cones* in the retina. Studies of vision indicate that the rods are for colorless vision and the cones for color vision. The rods contain a chemical substance, *visual purple,* which in the presence of light undergoes a chemical transformation. The chemical change gives off energy which sets up a nerve impulse; this impulse travels to the brain by way of the optic nerve. In the absence of light the visual purple in the rods is rapidly restored and they become more sensitive to light impressions. The reception of color impressions by the cones is not well understood. It is thought, however, that there are three types of cones scattered throughout the retina. Each type of cone is sensitive to one of the three fundamental colors with intermediate shades being seen due to stimulation of various combinations of color sensitive cones.

There are some persons who are unable to distinguish between various colors. These are spoken of as "color blind" individuals. This is a heriditary condition which occurs, to some degree, in 4.0 per cent of males and 0.4 per cent of females. Color blind individuals vary con-

siderably in the degree of their deficiency. Some are unable to distinguish one color (red, green, or violet), some cannot distinguish two of these colors, and still others cannot distinguish any of the three colors. This condition is thought to be caused by some abnormality in the cones of the retina.

It is well known that night vision improves with the passage of time spent in darkness. This is known as *dark adaptation* and is due to: (1) the dilation of the pupil so that more light is admitted to the eye, and (2) the restoration of visual purple. The process of adaptation can be hastened by wearing red colored goggles for about 30 minutes before attempting to see in the dark. These glasses exclude the light rays

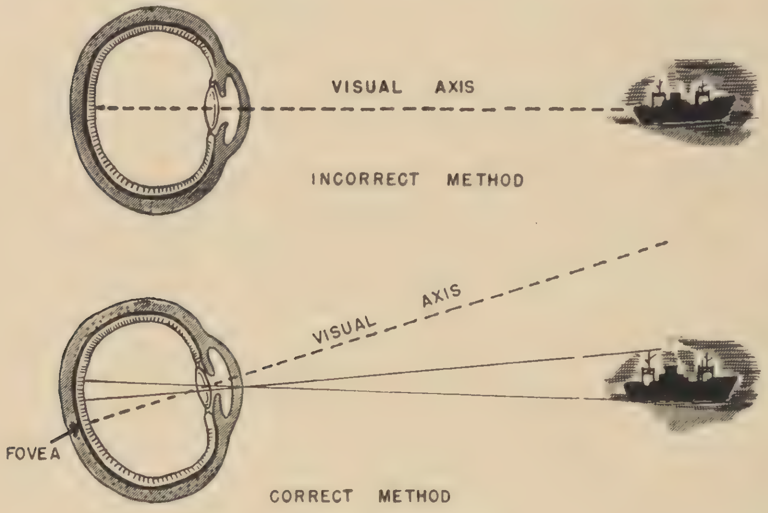


Figure 45. Night vision.

which destroy the visual purple thus allowing its replacement. Hence at the end of the adaptation period, the eye is at maximum efficiency so far as visual purple is concerned. It should be remembered, however, that exposure to ordinary light for a few minutes destroys the dark adaptation. Studies have revealed that at least two other factors play a part in the improvement of night vision: (1) position of the eyes, and (2) diet. The *fovea centralis* (point of maximum visual acuity) is located near the center of the retina. The fovea centralis does not contain rods and is less sensitive for the detection of motion or dim light than the remainder of the retina. The detection of motion or dim objects is best accomplished if the observer instead of looking

directly at the object gazes to one side as shown in Figure 45. The dietary factor involves the intake of vitamin A. In individuals whose diet is lacking vitamin A the normal function of the rods is impaired, hence for good night vision a diet adequate in this vitamin is desired.

HEARING

The organ of hearing is divided into three distinct parts: the external ear, the middle ear, and the inner ear, (Figure 46). The outer and middle ear are not sensory in the strict sense of the word as they merely serve to transfer the sound waves to the inner ear which is the auditory receptor. The external ear consists of the *pinna* which is a trumpet-like structure through which the *auditory canal* opens to the outside. The

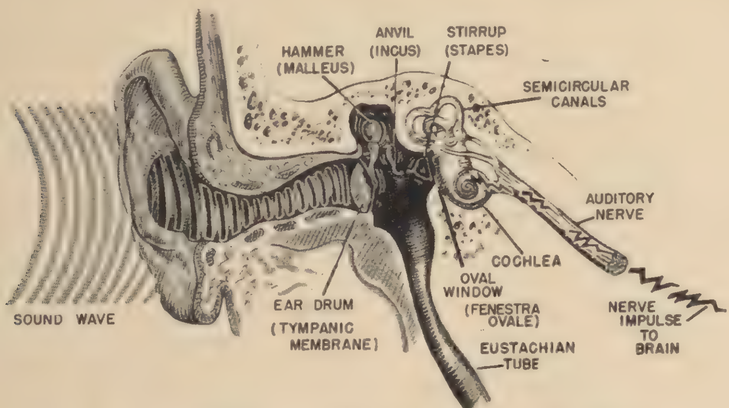


Figure 46. Schematic representation of sound perception.

inner end of the external ear is marked by the *tympanic membrane*. The middle ear is an air-filled chamber containing three small bones: the *malleus,* the *incus,* and the *stapes* which are spoken of collectively as the *auditory ossicles*. These three bones transfer the sound vibrations from the tympanic membrane to the inner ear. Extending from the middle ear chamber to the pharynx is the *Eustachian tube* which serves to maintain equal air pressure between the middle ear and the environment. The inner ear is composed of a spiral shaped structure, the *cochlea*. The cochlea is made up of three tubes, the middle one being lined with "hair-cells" which vary in height. The other two tubes are filled with a fluid (perilymph). The two fluid-filled canals are closed off from the middle ear by membranes known as the oval and round windows.

Sound perception is accomplished in the following manner. The sound waves enter the auditory canal and set the tympanic membrane vibrating, (Figure 46). These vibrations are then transmitted to the auditory ossicles which, acting as a series of levers, transfer them to the inner ear. Within the inner ear the vibrations stimulate the hair-cells. As the result of this stimulation, a wave of excitation is set up which passes along the auditory nerve to the brain where it is interpreted as hearing.

BALANCE

The organs which provide the body with a sense of balance are the *semicircular canals* which are closely associated with the inner ear. This organ is composed of a series of three canals filled with fluid and so arranged that one lies in each of three planes, (Figure 47). Because of inertia, motion of the body brings about motion of the fluid (endolymph) in the canals. The fluid thus caused to move, flows into an enlargement at the end of the canal. The presence of fluid in this enlargement stimulates the end-organs which in turn send a nerve impulse to the brain indicating the position of the body. In addition, this stimulus sets up a series of reflex actions which tend to correct the body position. Unusual motions sometimes so stimulate the organs of equilibrium as to produce a sensation of nausea as seen in the case of sea-sickness.

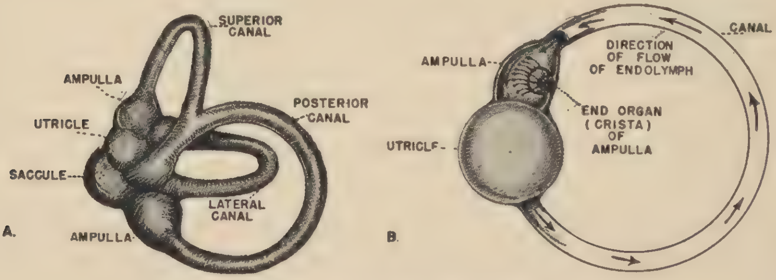


Figure 47. Diagram of the semi-circular canals.

MUSCLE SENSE

Nerve endings of *proprioception* are associated with muscle tissue. In skeletal muscle these nerve endings are either located in the muscle tissue or in the tendons. In non-striated muscle the nerve endings are located on the muscle fibers or between bundles of muscle. These end-organs serve to indicate the extent of movement of the muscles and the

position of various body parts. This sense is important in determining the accuracy of body movements and maintenance of balance.

SMELL

The end-organs of smell are located in the olfactory epithelium of the nasal cavity. These end-organs are stimulated by odorous chemicals which contact them. Associated with the end-organs are gland cells the secretion of which absorbs and dissolves the suspended odorous chemicals making it possible for the end-organs to detect them. The detection is facilitated by the fact that the substances stimulating the olfactory organs enter the nasal cavity with each inspiration. The amount of substance necessary to stimulate the sense of smell is, in some cases, extremely small. The sense of smell is associated through reflexes with secretion of saliva and gastric juice.

TASTE

The end-organs of taste, the *taste buds,* are located mainly on the tongue with a few being present on the soft palate. The taste buds are stimulated by the presence of chemicals which are in solution. The end-organs initiate four taste sensations: namely, sweet, sour, bitter, and salt. The sensitive areas for all four tastes are not equally distributed over the tongue. The tip of the tongue is most sensitive to sweet and salt, the back to bitter, and the sides to sour. Many so-called tastes may in reality be attributed to the sense of smell rather than actual taste.

PAIN

A sense of pain can be created by two means: (1) the over stimulation of end-organs not specialized as pain receptors, and (2) the stimulation of definite pain receptors. Any stimulus of an intensity great enough to harm the tissues will create a sensation of pain. Thus pain may be caused by such factors as excessive pressure, heat, and cold. In such cases the end-organs are not definite pain receptors but the intensity of the stimulus makes them give rise to pain sensations. On the other hand it is recognized that in some regions of the body there are definite pain receptors, as for example the cornea of the eye. Such pain receptors are easily stimulated and are probably protective in their action.

While it is possible to obtain pain sensations from internal organs, the intensity is much less than most people think. Some of the internal organs are insensitive to pain entirely and can be cut, torn, or burned

without sensation. When pain from internal organs does occur, it is generally not localized and frequently is "referred" to some region far from the site of damage. For example, in certain liver abnormalities the pain is referred to the back of the neck. The Hospital Corpsman should bear in mind that no matter how bad a wound looks there is little pain beyond that brought about by surface damage.

GLANDS OF INTERNAL SECRETION

Throughout the body there are many organs that manufacture specific products. These organs are known as *glands*. The products manufactured by glands are *secretions*. Glands are classified according to: (1) their mode of secretion (2) the nature of their secretory products, and (3) the site where the secretion is liberated. This section will discuss glands only according to the latter form of classification. Depending upon the site where the secretion is liberated, glands are divided into: (1) *exocrine,* those which pour their secretion on a surface; (2) *endocrine,* those liberating their secretion directly into the blood stream; and (3) *heterocrine,* glands that are both exocrine and endocrine in function. The secretory products of endocrine glands are *hormones*. These products are poured into the blood stream and are carried to all parts of the body. Hormones have the ability to bring about specific reactions in cells, tissues and organs. Thus, the hormones serve as "chemical messengers" in the body. A balanced activity of the hormone-producing glands is necessary to maintain normal body function.

The known endocrine glands are: the thyroid, parathyroids, pancreas, pituitary, adrenals, and the gonads, (Figure 48). In addition, there are several glands suspected of being endocrine but whose true function is still unknown. This latter list includes: the pineal body, thymus, and the liver. Each of the known endocrine glands produces at least one hormone which is specific in its action.

The *thyroid gland* is located in the neck region, just below the larynx, and ventral to the trachea. The glandular tissue forms an "H" with lobes on each side of the trachea connected by an isthmus. The hormone secreted by the thyroid is *thyroxin*. This hormone controls the rate of cellular oxidation. Hypofunction (below normal functional level) in children results in *cretinism* which is characterized by subnormal mental and physical development. Hypofunction in adults results in *myxedema*. In such cases the basal metabolic rate is below normal (—25%), and all body functions are slowed down. Hyperfunc-

tion (above normal functional level) is characterized by an elevation in basal metabolic rate as high as +70%. The body functions are speeded up and such symptoms as protrusion of the eyes, nervousness, tremor and loss of weight may be present.

The *parathyroid* glands are usually four in number with one imbedded in each tip of the thyroid gland. The hormone secreted by these glands is *parathormone*. This substance regulates the calcium and phosphorus metabolism of the body. Hypofunction results in tetanic convulsions, a condition in which the peripheral nerves and flexor muscles are hyperexcitable. Hyperfunction is characterized by a softening of the bones, skeletal deformity, and a loss of muscle tone. Hypofunction can be partially corrected by administering parathormone, calcium lactate, and large amounts of vitamin D.

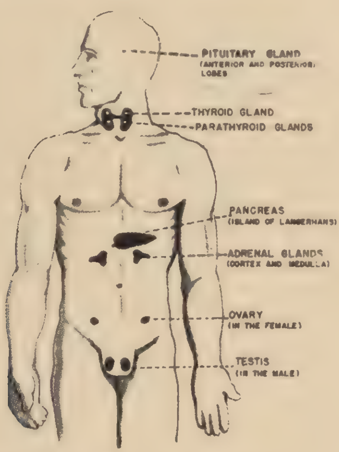


Figure 48. Location of the endocrine glands.

The *pancreas* is enclosed in a loop of intestine and extends across the abdomen behind the stomach. This gland is both exocrine and endocrine in function. The endocrine portion is composed of the *islet cells* known as the Islands of Langerhans. The hormone of the islet cells is called *insulin*. This hormone is necessary for burning of sugar by the tissues, and the storage of sugar in the liver. Hypofunction of the islet cells results in *diabetes mellitus*, a condition where the tissues are unable to burn or store sugar. Associated with this condition is predisposition to gangrene and a lowered resistance to infection. The administration of insulin will enable the individual to burn and store sugar but does not constitute a cure for the condition. Hyperfunction causes weakness, trembling, profuse perspiration and finally coma if not

corrected by the intake of sugar. This condition is rare except in cases where an overdose of insulin is taken.

The *adrenal* glands (suprarenals) are located one on the superior surface of each kidney. This is a dual gland, being composed of the *cortex* and *medulla*. The hormone of the outer portion (the cortex) is *cortin*. The function of this hormone is not well understood but it probably controls sodium metabolism and plays a part in maintaining the water balance. Hypofunction of the cortex produces Addison's disease which is characterized by weakness, loss of body weight, and a bronzing of the skin. True hyperfunction is unknown but tumors of the cortex are sometimes associated with virilism, a disturbance of the secondary sex characteristics in women. The hormone of the inner portion (the medulla) is *epinephrine*. The true function of this hormone is unknown. Many consider this the "fear hormone" as it brings about changes which prepare the individual for situations which might involve physical injury. However, its presence in the blood causes vasoconstriction, a decrease in coagulation time, an acceleration of the heart, and the discharge of glycogen (sugar) by the liver. The known effects are quite similar to those obtained by stimulating the thoracolumbar system. Epinephrine (adrenalin) has many clinical uses.

The *pituitary* gland is located in a depression (the sella turcica) of the sphenoid bone. This is a dual gland, being composed of the *anterior lobe* and the *posterior lobe*. Each lobe produces its own hormones. The secretions of the anterior lobe are numerous and present a very complicated picture. The anterior lobe hormones of known status are listed below.

HORMONES OF THE ANTERIOR PITUITARY GLAND

Hormone	*Function*
Phyone or Antuitrin G	Controls skeletal growth.
Gonadotropic Hormone	Maintains the reproductive organs in a functional state.
Prolactin	Stimulates milk production by the mammary glands.
Thyrotropic Hormone	Stimulates the thyroid gland to secrete.

The conditions arising from over functioning and under functioning of the anterior pituitary are beyond the scope of this presentation.

The posterior lobe of the pituitary secretes a hormone called *pituitrin*. This secretion causes the smooth muscles of the blood vessels, intestinal tract, and uterus to contract.

The *gonads* include the ovaries of the female and the testes of the male. These are mixed glands having both an exocrine and endocrine function. The location and function of these glands are discussed in the section on the Reproductive System.

THE MALE REPRODUCTIVE SYSTEM

The reproductive system is closely associated with the urinary system and is in some cases considered along with it. The male reproductive system is composed of: the *testes, epididymis, ductus deferens, seminal vesicle, prostate gland, bulbo-urethral gland, urethra,* and the *penis,* (Figure 49).

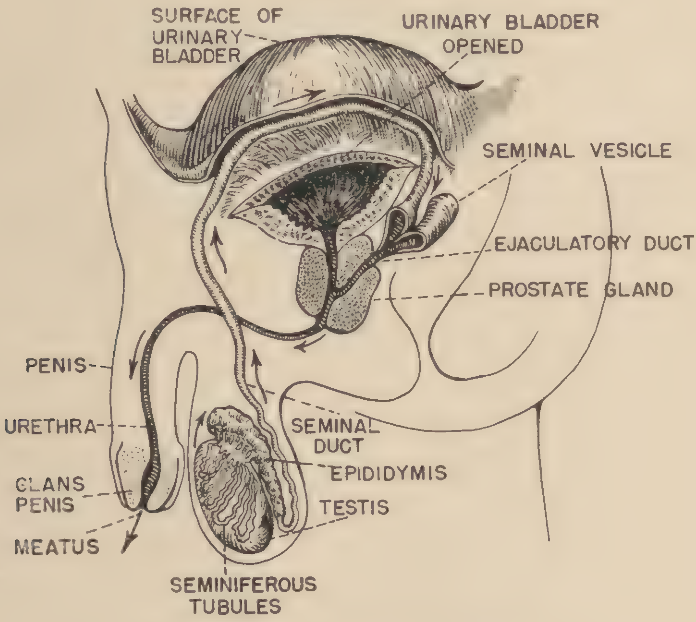


Figure 49. Male reproductive system.

The *testes* are paired oval-shaped glandular structures located in the scrotal sac. These glandular structures have a dual function: (1) the production of male reproductive cells, the *spermatozoa,* and (2) the production of the *male sex hormones* which determine masculine characteristics.

Lying along the side of the testis within the scrotal sac is a long narrow tube, the *epididymis.* This is the first of a series of tubes through

which the sperm pass on their course from the testis to the outside, (Figure 49). The epididymis functions as a temporary storage space and a transport tube. It leads directly into the seminal duct (ductus deferens) with which it makes connections while still in the scrotal sac. The *ductus deferens* is a thick-walled tube which transports the sperm from the epididymis to the seminal vesicle. The immotile spermatozoa are stored temporarily in the seminal vesicles. Upon leaving the seminal vesicles at the time of copulation the sperm pass through the *prostate gland* where an alkaline fluid is added which activates them to motility. This mixture of sperm and prostatic fluid passes into the urethra where the secretion of the bulbo-urethral glands is added. The mixture then passes out of the body by way of the urethra which runs through the penis.

The material (semen) leaving the body at the time of sexual intercourse (copulation) is composed of spermatozoa, secretions from the prostate gland, and secretions from the bulbo-urethral glands. The fluids added to the spermatozoa serve to activate the sperm, serve as lubricants, and also provide an alkaline medium which will protect the sperm from the acids encountered in the vagina of the female. About 4 or 5 cc. of this mixture leave the body at each ejaculation and will contain approximately 250,000,000 spermatozoa. The large number of spermatozoa produced when only one is necessary to effect fertilization is simply a means of insuring a sufficient distribution of sperm to meet the ovum regardless of its position.

The copulatory organ of the male, the penis, is a cylindrical mass of erectile tissue with an enlargement known as the *glans penis* at the distal end, (Figure 49). The major portion of the penis is composed of *cavernous tissue* which becomes distended with blood during sexual excitement. Due to the constriction of the veins draining the penis, the volume of blood entering the cavernous tissue is greater than that leaving, thus making the organ become firm and erect. Running through the penis is the urethra which opens to the outside by means of the *urinary meatus* at the distal end of the glans penis. The urethra serves to transport products of both the reproductive and urinary systems. Surrounding the glans penis is a loose skin known as the *prepuce* or foreskin.

A knowledge of the structure of the male reproductive system is important to the Hospital Corpsman because in addition to venereal diseases this system is subject to many injuries and deformities. Some of the more common being:

Phimosis, a condition where the foreskin cannot be retracted.

Paraphimosis, when the retracted foreskin produces a constriction of the penis.

Balanitis, an inflammation of the glans penis due to the action of bacteria under the foreskin.

Epididymitis, an inflammation of the epididymis with marked pain, swelling, and tenderness of the area. This condition is usually the result of gonorrheal infection.

Urethritis, an inflammation of the urethra which sometimes results in the formation of strictures. There are many causes of this condition with gonorrheal infection being the most common.

Prostatitis, an inflammation of the prostate gland. Functional retention of urine may result from this condition.

These and many other conditions of like nature may arise among members of the crew and require attention before reaching port.

THE FEMALE REPRODUCTIVE SYSTEM

The female reproductive system is composed of: the *ovaries, fallopian tubes, uterus,* and the *vagina.* The system functions to produce female reproductive cells (ova), to provide an environment in which fertilization can occur, and to retain the fertilized ovum through its period of development into a mature fetus.

The *ovaries* are oval-shaped structures located in the lower part of the abdominal cavity. They are lateral to the uterus and are below and behind the open fringed (fimbriated) end of the fallopian tube, (Figure 50). These bodies produce the female reproductive cells, the *ova,* and at least two internal secretions (hormones). The production of ova is cyclic with one ovum being produced every 28 days from the onset of puberty to the menopause. The ovary produces hormones which control the menstrual cycle, the events associated with pregnancy, and the maintenance of feminine characteristics.

The *fallopian tubes* extend from the area of the ovaries to the uterus. They are narrow about 4 inches long with a funnel-shaped expansion at the cephalic end. The fallopian tubes transport the ova from the ovary to the uterus. When the union of the spermatozoa and ova (fertilization) occurs, it is usually at the middle of this tube.

The *uterus* is a pear-shaped structure with thick muscular walls located in the inferior end of the abdominal cavity dorsal to the bladder. The lower end of the uterus is constricted to form the *cervix* by which it communicates with the vagina. The ovum passes from the fallopian

tube into the uterus where it is retained throughout the period of development into a mature fetus. Unfertilized eggs pass to the uterus and degenerate in a few days. The muscle wall plays an important part in expelling the mature fetus at the time of birth.

Below the uterus is located the muscular tube, the *vagina,* by which the reprodutive system opens to the exterior. The vagina is lined with a mucous membrane and is lubricated by the secretions from this membrane and those of the Bartholin glands. Under conditions of labor or birth the vagina is capable of great dilatation.

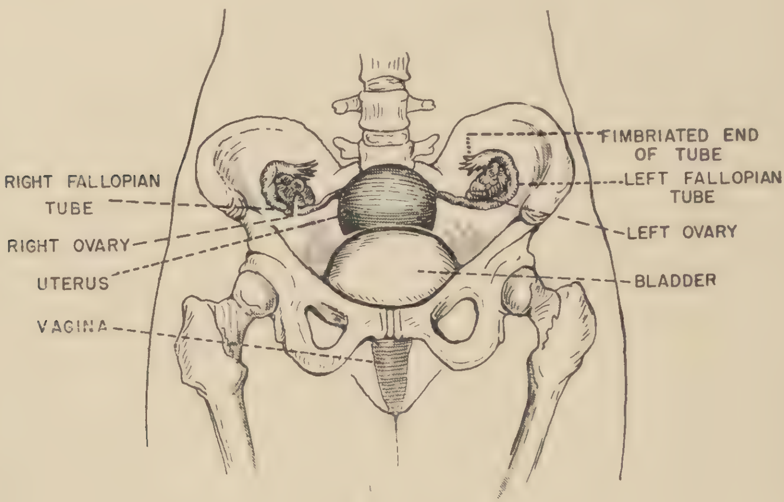


Figure 50. The female reproductive system.

Prior to ovulation, an ovarian hormone acts upon the uterus causing growth of the inner lining and an increase in the blood supply, thus preparing the uterus to receive the fertilized ovum. The ovum is shed from the ovary into the fimbriated end of the fallopian tube. It passes down the tube to meet the spermatozoa and become fertilized. After fertilization the ovum passes on to the uterus. The fertilized ovum becomes buried (*implanted*) in the wall of the uterus and begins to grow. Around the developing ovum are formed the *fetal membranes,* (Figure 51) which grow with the embryo providing nutrition and protection. These membranes are expelled at the time of birth and together with the placenta form what is known as the "after birth." The developing embryo obtains its nutrition through the umbilical

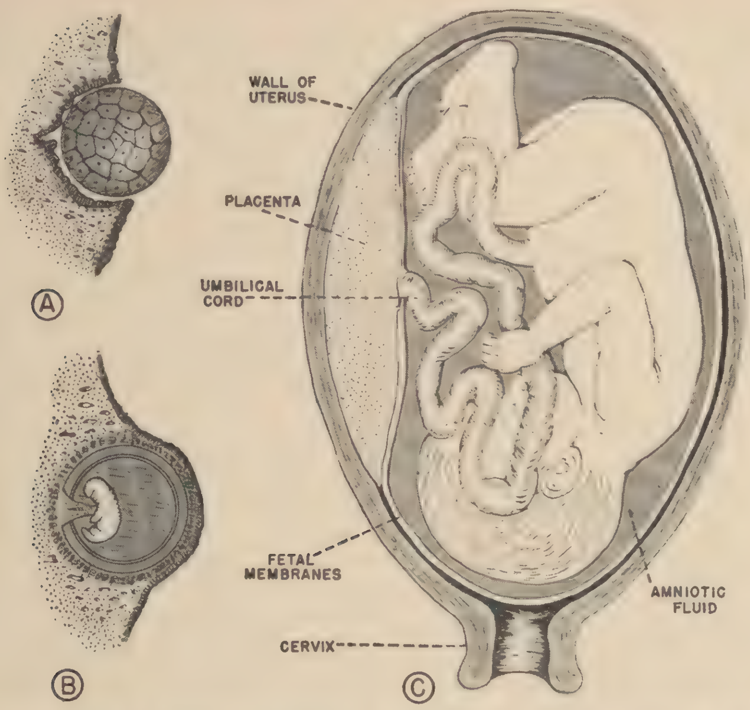


Figure 51. Stages in human development: A. implantation; B. early stage of embryo; C. mature fetus.

cord which runs to the *placenta,* (Figure 51). The nutrient material passes from the placenta to the embryo through the blood vessels of the umbilical cord. Growth of the embryo is quite rapid as evidenced by the following table.

Age of embryo	*Crown-heel length* *Inches*
2 weeks	¼
4 weeks	½
8 weeks	1
20 weeks	10
40 weeks	20

At the end of ten lunar months (280 days) birth (parturition) occurs. This process is divided into three stages: *dilation, descent,* and the *placental* stage. During the first stage the cervix is enlarged to permit passage of the mature fetus. In the second stage the fetus passes out through the vagina. During the third stage the fetal membranes and the placenta are expelled from the uterus.

THE SKIN

The skin is an epithelial tissue forming the outer body covering. It contains such appendages as the hair and nails, and certain glands such as the sweat and sebaceous glands. The skin has several functions, the most important of which are: (1) forms the outer cover of the body, (2) protects the body from drying, (3) the unbroken skin serves as a protection against the entrance of foreign organisms, (4) takes an active role in regulating the body temperature, (5) functions as a sense organ to the extent that it contains receptors for receiving impressions regarding the environment, (6) serves as an excretory organ by virtue of eliminating waste through perspiration, and (7) has limited powers as an organ of absorption.

The skin is composed of two layers, the *epidermis* and *dermis*. The epidermis, the outer of the two layers, may be further divided into: (1) the outside, hard, horny layer, the *corneum,* and (2) a soft layer in which cell multiplication is taking place, the *germinativum*. This outer layer contains no blood vessels nor nerve endings hence is for all practical purposes insensitive to injury. The outermost part of the epidermis is composed of dead cells which are constantly being removed from the surface and replaced by new cells from the growing layer (the germinativum). In body areas where there is constant wear the outer layer of dead cells becomes quite thick and cornified (hardened) as evidenced by the condition found on the palms of the hands and the soles of the feet. The inner layer of the skin, the *dermis,* is much thicker than the epidermis, (Figure 52) and in contrast to it, is highly sensitive. The dermis is well supplied with nerves, blood vessels, lymph vessels and also contains the sweat glands, hair follicles and sebaceous glands. The major portion of the dermis is composed of loose connective tissue from which the skin derives both its tough quality and its elastic properties.

The skin has numerous special structures such as the nails, hair and sweat glands which have a varying distribution on the body. While none of these structures are composed of skin, their association with and origin from the elements which compose the skin is so close that they cannot be divorced from it.

On the distal ends of the dorsal side of the phalanges are located the *nails*. These are composed of horny epidermal cells with their growing points located in the fold at the proximal end of each nail. In the beginning the cells forming the nail are as soft as skin cells but as they grow out they lose their cellular characteristics and

form a hard solid plate of material. If a nail is broken or destroyed it will be replaced provided the germinative cells in the fold from which the nail grows are not destroyed.

The distribution of hair over the body surface varies considerably in different individuals but in general it will be found on all body surfaces with the exception of the soles of the feet, palms of the hands and the last digits of the fingers and toes. The hairs grow out from the hair follicles located in the dermis but in reality the hair is a product of the epidermis whose cells have pushed down into the dermis, this can be clearly seen by tracing the cells forming the follicle in Figure 52. Hair growth occurs from the bottom of the hair follicle with the shaft being continuously pushed outward. Associated with the hairs are the sebaceous glands which secrete an oily substance to protect the hair and the skin against drying. The dirt collecting in the openings of these glands frequently leads to the formation of "blackheads" or even more extensive skin irritations and possible subsequent infections.

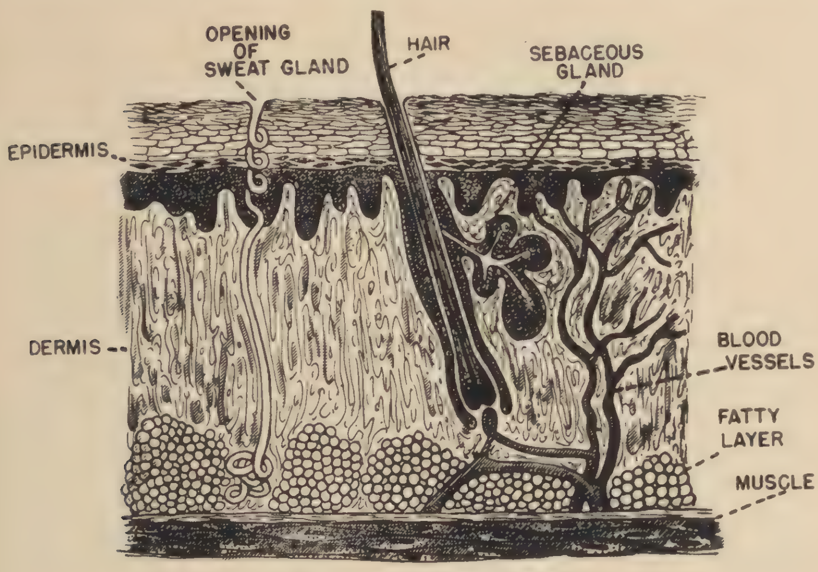


Figure 52. Diagram of a section of the skin.

The sweat glands are found all over the body surface but are more abundant in some areas than others. Each gland is composed of a coiled tube. The glandular portion is located in the dermis with an opening to the surface by means of a duct which terminates in a tiny pore. The secretion of these glands is composed largely of water together with

some organic and inorganic salts. The volume of perspiration secreted per day is about 500 cc. but there is wide variation due to physiological and environmental conditions. Some of the factors causing an increase in perspiration rate are: high temperature, exercise, and emotional excitement. The perspiration rate is decreased by low temperatures, diarrhea, and certain drugs.

The human body ordinarily maintains a temperature from 97.3° to 99.1°F (average 98.6°F) regardless of the external environment. Great deviation from this temperature cannot be tolerated even for short periods of time. Temperature control is discussed here because of the important role played by the skin. The body heat is generated by the metabolic activities which are constantly occurring in the tissues, particularly the muscle tissue. If all the heat generated were retained by the body the individual's temperature would rise considerably beyond the normal range. Such is not the case, however, as heat is lost through: radiation from the surface, breathing, the elimination of urine and feces, the warming of cold material taken into the body and other methods mentioned below. The balance between the heat generated through metabolism and that lost through radiation is not sufficient to maintain a "constant" body temperature. Here the skin with its blood vessels plays its important part in establishing the proper balance. When the body is exposed to low temperature, a reflex is set up which brings about a vaso-constriction thus reducing the volume of blood in the skin available to radiate heat. There is also a contraction of the superficial skin muscles forming "goose pimples" which further off-sets the effect of radiation and thus retains body heat. On the other hand, when the body is exposed to high temperatures, the skin blood vessels dilate thus increasing the amount of blood at the body surface, resulting in increased heat radiation. In addition to the vaso-dilation in response to high temperatures the sweat glands become active, secreting water on the surface of the body. The evaporation of this water tends to cool the body. Thus there is established a mechanism which regulates the body temperature and maintains it within the normal range.

Chapter II

DISEASE PREVENTION

Quarantine Inspection

The ships of America's Merchant Fleet sail to all quarters of the globe. Her seamen are exposed to adventures which accompany wide travel; they have opportunity for an interesting and educational life. Unfortunately however, these men are also exposed to disease. Both

ships and men may become vehicles for the spread of disease from port to port, from country to country; the seaman's life of adventure may be changed to one of sickness, misery, and despair. This book has been prepared to aid in the maintenance of a merchant marine whose ships are clean, whose men are free from disease, and whose men may lead robust, adventurous lives while contributing toward the real progress of civilization.

It is expected that the Hospital Corpsman will appreciate the great need for cleanliness and for scientific sanitary management. The values in terms of health, comfort, and safety should be apparent to all seamen, but the Hospital Corpsman may have to point this out occasionally. The following material is intended to supply the student with the necessary scientific knowledge concerning disease prevention. Some portions do not apply specifically to ships, but are included for the purpose of providing the student with a better general background in the subject. The student should not be content with simply learning sanitation as a bit of technical knowledge. It will be his job to apply these principles when he ships out. This effort will be a distinct challenge, for the achievement of the objectives will require his individual intelligence and initiative, as well as the cooperation of all the men.

In order to accomplish his purposes, the Hospital Corpsman should be able to explain the values and benefits of good sanitation. The first step lies in securing knowledge of conditions which might cause the spread of disease. Control of such conditions leads to the prevention of deaths, prevention of loss of man-hours through illness, and at the same time aids in maintaining peak physical condition among crew members. The expense and worry that accompany disease may be minimized. Pleasant and more comfortable surroundings will also result. Damage to cargo, food stores, and even damage to the ship structure through insects and rats may be avoided. A clean ship, carrying an officer who is responsible for its sanitary maintenance, will be able to clear quarantine with less delay. Quarantine officials have observed that quarantine procedures are greatly facilitated, and fumigations are less frequently required on ships which carry a responsible sanitary officer.

Aboard merchant ships, much can be done to improve the conditions affecting the health of the crew. The Hospital Corpsman should learn which areas of the ship are most likely to act as foci (centers) for the spread of disease, and then should act to enforce the necessary hygienic and sanitary principles. This will not be an easy task; the Hospital

Corpsman must work through suggestions or recommendations to other officers, and through education of crew members. Experience on the job will reveal that the officers and crew members are willing to cooperate and do all they can to aid in maintaining healthy conditions. In most cases, lack of understanding and lack of interest tend to create shoddy conditions which endanger the sanitary maintenance of the vessel. Most American merchant ships are carefully planned and well constructed. It is possible to maintain good, clean conditions in all parts of the ship; however, sanitary maintenance is not automatic or effortless. Attention, thought, and physical exertion are needed to maintain a clean ship and a healthy crew. Too often, one of these factors is neglected. It is interesting to notice the conditions of the engine-room and to compare this area with other divisions. Sometimes the observer will find the engine-room absolutely spotless, while on the same ship, the bunkroom, mess-halls, and galleys may be in poor condition. Such discrepancies are due largely to the difference in the care exerted in those areas. The officers and crew appreciate the dangers of engine trouble, but do not fully realize the dangers of poor sanitation and unhealthy conditions.

INFECTIOUS DISEASE

Disease may be described as a condition of ill health or, in other words, any interference with the normal structure or function of the body. Some diseases may be due to degeneration of tissues, malnutrition, or other disturbances of normal body activities. Such diseases are not due to "germs" or micro-organisms and therefore are not spread from person to person. Another group of diseases, called infectious diseases, are the result of the invasion of the body by micro-organisms. These infectious diseases require the largest part of our attention, since they can be spread. If a seaman becomes ill with an infectious disease, he may spread that disease throughout the crew, and the disease may be carried from port to port.

In this study of preventive medicine, emphasis will be placed upon the control of infectious disease. Non-infectious disease can be eliminated from the crew largely by means of "sign-on" medical examinations. Infectious disease, however, may occur at almost any time and during any phase of the voyage. The Hospital Corpsman will find that a crew member may pick up a disease in port but show no symptoms at all until the ship is at sea. This is because the disease has an *incuba-*

tion period, the time between the exposure to disease and the day on which first symptoms appear. These incubation periods for different diseases may range from a day or two to several weeks. Thus it is possible for a healthy man, processed through medical examination at "sign-on", to come down with disease several days out of port or even after a few weeks at sea. Furthermore, such disease may be spread from one seaman to another through the close contacts that accompany ship-board activities and conditions. This may result in the illness of many crew members, leaving the ship undermanned. It is an important duty of the Hospital Corpsman to make himself aware of these dangers and to take the necessary action to save the lives of crew members and to maintain their good health.

The training of Hospital Corpsman for the Merchant Marine was instituted shortly after the beginning of American participation in World War II. In any war period, the control of infectious disease becomes a problem of major importance for every country, and new facilities must be established to meet the dramatic changes that accompany a war era. The creation of the Purser-Hospital Corpsman was one of these adjustments made to aid in saving lives and preventing disease. It was hoped that he would be able to play an important humanitarian role in this regard, by applying technical knowledge to existing conditions and to emergency situations.

In war activities, great numbers of men must be gathered from all parts of the nation for mass training and military activity. Such concentrations greatly increase the possibility of disease transmission through increased exposure. Many other factors also increase the disease dangers. Travel is greatly accelerated through movement of civilians, recruits, troops, refugees, war prisoners, and returning wounded or diseased service men. Hardships of war undermine the health of the population through fatigue, exposure, malnutrition, lack of facilities for proper sanitation, and lack of sufficient medical care to handle the tremendously increased load.

The history of war and disease presents an interesting study. In wars before the present century, far more men in armed forces died from disease than from action in the field of battle. There are instances where entire armies have been wiped out by infectious disease. An outstanding example of this occurred in the Bavarian Army in 1812 when, out of 28,000 men, 25,000 died of typhus. The well-known retreat of Napoleon from Moscow was accompanied by the death of 40,000 French soldiers through typhus fever. Typhus fever is spread by lice

and fleas, which accounts for its ravages in war periods when personal cleanliness and general sanitation are not maintained.

Another very serious insect-borne disease is bubonic plague, a disease of rats which is spread to man by the rat flea. This disease broke out in severe form many times in Europe during the Middle Ages and was known as the "Black Death". The flea is commonly found on rats which inhabit wharves and other waterfront structures associated with shipping. The rat has always been a menace aboard ship as well. For these reasons bubonic plague has been particularly dangerous in seacoast towns and in shipping activities.

Smallpox was a great scourge in Europe. There was a long history of recurrent epidemics until vaccination became widely used in the 1800's. In 1870, France lost 23,000 men through smallpox, while the Germans lost only 200. The Germans used proper vaccination methods to immunize their troops against smallpox while the French armies failed to use such protection.

Three major intestinal diseases have played terrible havoc with military forces. Dysentery, cholera, and typhoid fever are intestinal diseases, spread primarily through food and water in the absence of careful sanitation. In Germany, during the Austro-Prussian War in 1866, 100,000 persons died from cholera. Typhoid fever has often impaired American troops; it was an outstanding cause of death in the American Civil War and caused many fatalities in the Spanish-American War.

During World War I, more fighting men were killed by battle injuries than were killed by infectious disease. This may be attributed to great improvement in sanitation and preventive medicine, as well as to the fact that the machinery for slaughter was becoming more efficient. In Western Europe, tremendous effort in preventive medicine was exerted to check such diseases as smallpox, typhus, cholera, and dysentery. Smallpox vaccination was widely used. The value of typhoid vaccination was also proven dramatically. During the month of January 1915, the French Army had 14,000 cases of typhoid fever; by December of 1916, the number of cases of typhoid had been reduced to 300 for that month. This remarkable difference was due primarily to the introduction of typhoid inoculations during the interval. Over the entire war period, the German Army lost 1,500,000 men in battle and only 155,000 by disease. This is an excellent demonstration of the values of preventive medicine.

The major disease-problems of the United States forces in the First World War were respiratory diseases, such as influenza, pneumonia, tuberculosis, and bronchitis. Venereal diseases, chiefly syphilis and gonorrhea, were also serious. Many cases of mumps and measles occurred, but of course deaths were few. In the Navy, disease rates for men ashore were much higher than the rates for men at sea. The men ashore were subject to greater exposure, while the men on ships formed isolated groups where new diseases were not so easily introduced. In "boot training" ashore, men from all over the country mingled in close quarters under new conditions, while on ship the men were more adjusted in personal protection and in the maintenance of sanitary living conditions.

In many parts of the world, civilians were also suffering disease at this time. In Russia, the war and post-war periods were marked by famine and disease. There was an overwhelming lack of food, fuel, shelter, drugs, and hospital and medical facilities. The outbreaks included cholera, dysentery, typhoid, typhus, malaria, and relapsing fever. In 1919-20, Russia reported 5,000,000 cases of typhus and 1,260,-000 cases of relapsing fever among civilians alone. In many of the other countries, most of the adult infectious diseases increased during and after the war. Respiratory diseases became relatively more important; influenza especially, and also tuberculosis and pneumonia. Sanitary control and immunization effectively lowered the rates of the intestinal diseases.

World War II saw infectious diseases fairly well under control, with a few exceptions. The difficulties of prevention were tremendous. Many hundreds of thousands of Amreicans were invading new areas and new continents to meet strange conditions and "foreign" diseases. Because of the huge area covered and because of the nature of the struggle, facilities to control these diseases were limited. Nevertheless, American forces were well protected by means of immunization, constant vigilance in hygiene and sanitation, and excellent treatment of cases. Chemotherapy, especially the use of sulfa drugs and penicillin, was of tremendous value.

In the European theatre of operations, respiratory diseases were dangerous. Influenza was at a high level, and was wide-spread in England in 1943. However, the disease was a mild form. Eastern Europe experienced many cases of typhus, especially Poland and Rumania. During 1942 and 1943 typhus was reported in Germany to the extent of an average of 100 cases a week. In occupied countries,

such as Greece, starvation and serious malnutrition were reported. Whether or not the health authorities can prevent pestilence such as we have seen following past famines, we have yet to learn.

In the Pacific theatre, malaria was the "Number One" disease-problem of the United States forces. It is estimated that 85% of the troops on Bataan in 1943 had malaria, and an over-all estimate of 50% has been quoted for this area. Serious military reverses have been attributed to the effects of malaria on various military forces. Dysentery and diarrhea were also serious in the Pacific area where maintenance of sanitary conditions was difficult and where flies and other insects were numerous. In the China-Burma-India area, diseases associated with poor sanitation were prevalent, and one of the periodic cholera epidemics again swept through India in 1943.

During World War I, Allied seamen faced the task of forming a bridge of ships to move men and supplies to Europe, chiefly to England and France. Over 2,000,000 men, plus huge stores of equipment, were transported to Europe before the armistice. Many of the transports were converted or modified cargo vessels. Ship sanitation became a vital problem, including the maintenance of general cleanliness, proper ventilation, and proper food supplies. With thousands of men aboard a transport, the outbreak of an epidemic might well be disastrous. There were a few such incidents during the world-wide influenza outbreak. For example, in September, 1918, the U.S.S. Leviathan left her dock at Hoboken, N. J., with about 9,000 men aboard. All of these men had received physical examinations, but many of them must have had influenza concealed in the symptomless stage, because on the following morning, all sick-bays were filled to capacity. By the evening of the second day, 700 cases of influenza were discovered. By the time the Leviathan reached Europe, there had been 2,000 cases of influenza, with 91 deaths.

The events of World War II have demonstrated that American vessels and American seamen can operate the greatest shipping schedule in history. Ships carry men and supplies, not just across the Atlantic, but to every part of the world. Seamen were exposed to diseases in England, Russia, Italy, North Africa, South America, the South Pacific Islands, India, China, and other areas. Obviously, exposure to many different diseases occurred. Merchant seamen contracted cholera in India, dysentery in the South Pacific, and venereal diseases in many ports. Steps were taken to minimize the dangers of disease; physical examinations and certain immunizations were required of merchant

seamen by the War Shipping Administration. Hospital Corpsmen were placed aboard merchant ships, and the U. S. Army, Navy, and Public Health Service strove to check disease in war areas. Some of these activities which affect the Merchant Marine are explained in the following text.

HOW DISEASES ARE CAUSED

Successful disease prevention depends upon knowledge of the causes and the methods of transmission of disease. If the cause is known, the source may be discovered and eliminated. If the source of the disease cannot be eliminated, a barrier to its spread may be created to prevent the development of new cases.

Every disease has some underlying cause or causes; sometimes these are easy to discover, other times very difficult. A number of common ailments are not caused by "germs", but may be due to various physiological and environmental factors. For example, a merchant seaman who has been through harrowing adventures, including torpedoing or other shipwreck, may develop gastro-intestinal disturbances. These seem to be the result of physiological upsets brought about by emotional and nervous conditions. Similar experiences may also cause serious mental conditions which, though unaccompanied by physical disturbances, may place the individual in the sick category. Many other internal conditions may occur that are not caused by "germs"; kidney, liver, or heart may function improperly as the result of deterioration or through misuse of the body.

The layman usually thinks of infectious diseases as caused by "germs". This is not a very specific term, and the Hospital Corpsman should have a more scientific understanding. He should realize that the causative agents of infectious disease may be of several different types. Most of these agents are too small for observation with the unaided eye, and are called *micro-organisms*. It should be noted that the word micro-organism includes all minute forms of plant or animal life, whether harmless or harmful. Fortunately, the vast majority of micro-organisms are not harmful to man. Those which can cause disease are designated as *pathogenic* micro-organisms. The pathogenic agents described in this chapter include bacteria, viruses, Rickettsia, protozoa, fungi, and worms.

Bacteria are minute micro-organisms, many of them measuring only 1/25,000 of an inch. They are usually considered as members of the plant kingdom. A bacterium is a single cell capable of all functions of life. The bulk of its structure, like that of all plant and animal

cells, is composed of the basic substance called protoplasm. The outer boundary of this cell is called the cell wall. In addition, certain bacteria may possess specialized structures. Some are enclosed in a capsule which offers them protection. Other bacteria are capable of forming spores; these spores are formed by concentration of the vital cell elements into a compact mass within the cell. The cell itself may die, but this spore is much more resistant and may live through conditions which would ordinarily kill the cell. The spore is able to remain dormant for a long period of time, perhaps for many years, and then is able to grow when it reaches favorable surroundings. For these reasons it is very difficult to destroy spore-forming bacteria. A number of bacteria are capable of limited movement under their own power within fluid media. This may be accomplished in either of two ways: spirochetes are able to move by means of an undulating motion of the cell itself; many bacilli are also capable of motion with the aid of a special whip-like structure, the flagellum.

There are many thousands of different bacteria, but the Hospital Corpsman will be most concerned with the pathogenic bacteria. These may cause disease by invasion of the body tissues of the victim. Here they may destroy cells and produce toxins (poisons) that result in serious illness or death of the person involved. Most of the pathogenic bacteria are parasitic, which means that they grow and develop on living tissue. Pathogenic bacteria grow best at the temperature of the human body, but they can often adjust to a fairly wide range of temperature. Extreme changes of temperature, especially heat, will kill these pathogenic bacteria.

The discovery of bacteria did not occur until after the invention of the microscope. Micro-organisms were first observed about 1675 by use of this instrument in a crude form. However, almost 200 years passed before bacteria were thoroughly appreciated in their relation to disease. The period 1880-1890 became the "Golden Age of Bacteriology"; the works of great bacteriologists and medical men interested in bacteria became recognized and were applied widely in medical practice. The works of many noted men such as Pasteur and Koch were accepted in this era. Through the work of these men and hundreds of others, a wealth of information was compiled regarding the characteristics of bacteria and their role in producing disease. Koch formulated a very valuable set of rules to follow in proving the relation between a disease and the micro-organism that is suspected as the causative agent. These four postulates are:

1. Obtain the bacteria from the patient, and identify these bacteria.

2. Grow the organisms in a pure culture (free from any other organisms).

3. Inject the organisms into a laboratory animal and produce the disease.

4. Then obtain the organisms from the diseased animal and again examine the organisms to see if they are the same that were recovered from the original patient.

Meanwhile, numerous other scientists were at work investigating bacteria; their studies led, among other things, to a system of classification of bacteria. Bacteria are placed into several major categories according to form or shape of the organism.

1. *Cocci* (pronounced "cocks-eye") (singular-coccus). This group is composed of bacteria which are spherical in shape. They are further subdivided on the basis of the manner in which they group together during growth:

a. *Micrococci* remain as separate or single organisms.

b. *Diplococci* occur as pairs.

c. *Streptococci* occur in chain-like formations of numerous cocci.

d. *Staphylococci* appear in irregular groups, frequently resembling the formation of clusters of grapes.

2. *Bacilli* (singular-bacillus). The category includes all rod-shaped bacteria. They vary considerably in length; usually the length is approximately ten times the diameter, although some bacilli are so short that it is difficult to judge whether they are bacilli or cocci. The bacilli are the most frequently occurring form of bacteria. The grouping or clustering of bacilli is not characteristic as in the case of cocci, and is not often used as a feature in their classification. Many bacilli possess flagella which permit independent motility. Spores are an additional characteristic possessed by many bacilli.

3. *Spirilla* (singular-spirillum). The spirilla, as the name implies, are of a spiral or modified-spiral shape. They are the least common form of bacteria. Some spirilla are motile.

The spirilla proper are relatively rigid organisms, actually spiral in shape.

The sub-division known as the *vibrio* group are comma-shaped organisms.

Spirochetes appear as long, slender, and flexible spirals. Most spirochetes are motile.

Thus, bacteria are first classified in the above groups according to the shape of the cell. Numerous other distinctive features may also be studied for further identification, to form smaller and more exclusive

subdivisions. Although these categories are not absolute, they are a great asset in the recognition and the appreciation of bacteria.

1. On the basis of their effects upon the human body (or other hosts), bacteria may be divided into:

   a. *pathogenic*—capable of producing disease.

   b. *non-pathogenic*—not disease-producing.

2. According to their oxygen needs, bacteria may be classed as:

   a. *Aerobic*—live best in the presence of oxygen (air).

   b. *Anaerobic*—live best in the absence of oxygen.

3. The ability of movement is a feature which results in classification of the organisms as:

   a. *Motile.*

   b. *Non-motile.*

4. The ability to produce spores may be determined, and may result in classification of the organism as:

   a. *Spore-former.*

   b. *Non-spore-former.*

5. Numerous subdivisions are derived from analysis of nutritive requirements of bacteria. However, only two of these groupings are of immediate importance to the Hospital Corpsman:

   a. *Parasitic* bacteria are those which require other living matter as a source of nourishment. Parasitic bacteria are injurious to this other living form (the latter is usually called the "host"). Most pathogenic bacteria are parasitic.

   b. *Saprophytic* organisms are those which obtain nourishment from dead organic matter, such as dead tissues.

6. A number of other features are also used in the recognition of bacteria, for example temperature needed for best growth, or reaction to various stains. The student should refer to a standard textbook of bacteriology for further information of this nature.

Note that the description of a certain bacterium may involve several of the features outlined above. For example, the causative organism of tuberculosis, *Mycobacterium tuberculosis,* may be classified as a bacillus. Furthermore, it is pathogenic, aerobic, non-motile, and parasitic.

Viruses constitute another group of agents which may cause infectious disease. As in the case of bacteria, there are many different viruses. They are much smaller than bacteria and cannot be seen with the regular microscope; in recent years a number of viruses have been photographed by means of the electron microscope. Before they were actually seen, their existence was determined by scientific experiments to prove their presence. Although there is no decision as to whether

or not the virus is "living matter", we do know that it will reproduce in the presence of living tissue. The size of the virus, and its structure resemble the features of large chemical molecules, but the ability to multiply is a characteristic of living matter. Therefore, a virus is regarded today as a form intermediate between living matter and chemical units.

Mention should also be given to *Rickettsia,* another separate group of micro-organisms capable of producing disease. Rickettsia are the causative agents of typhus fever, Rocky Mountain spotted fever, and tsutsugamushi fever.

Protozoa constitute another important group of infectious agents. Protozoa are one-celled micro-organisms classified with the animal kingdom. In general, they are larger than bacteria, and many are large enough to be seen distinctly with the low power (100x) of a microscope. Protozoa are very widely distributed throughout our surroundings. Fortunately, the large majority are harmless. A number of tropical diseases are produced by protozoa, although protozoan-caused diseases are not limited to the tropics. Outstanding among the protozoan group of diseases are malaria and amoebic dysentery.

Fungi are small plant structures, also prevalent in our environment. Many are harmless, and some are beneficial, but a relatively small proportion of them are disease-producing. Some are parasitic; most are saprophytic. Warmth and moisture are especially conducive to their growth, hence they are more common and more dangerous in tropical areas. A number of them attack the skin of the host, as, for example, in the case of "athlete's foot". The latter is produced by a fungus known as epidermophyton.

Several diseases caused by worms are described in other parts of this book, including tapeworm, trichinosis, and hookworm. Worms are multi-cellular organisms of the animal kingdom; some are sufficiently large to be seen with the unaided eye.

HOW DISEASES ARE SPREAD

If any infectious disease breaks out aboard a merchant ship, it is the duty of the Hospital Corpsman to care for the patient and to prevent the spread of that disease. The Hospital Corpsman should appreciate fully the dangers of an outbreak aboard his ship; if many cases of serious disease occur, the sick-bay facilities, medical supplies, and the time of the Hospital Corpsman may not be sufficient to cope with the problem. Meanwhile, the efficient and safe operation of the vessel is endangered. A Hospital Corpsman should also realize the

personal dangers to which he is exposed; as part of his duty, he will of necessity be in close contact with his patients in the sick-bay, and will therefore be in constant danger of exposure. To meet these problems, the Corpsman should be thoroughly familiar with the manner in which diseases may be spread. He should know how the micro-organisms enter the body; understanding of this will be of great aid in protecting himself and others against these diseases.

There are several distinct routes by which infectious organisms enter the human body and create disease. They may enter by way of the skin, the respiratory tract, the alimentary tract, and the genito-urinary tract. Normally, the skin presents an unbroken surface which keeps bacteria out; this may be aided by personal cleanliness. Breaks in the skin allow the entrance of bacteria and permit the establishment of an infection. The respiratory tract, including nose, throat, and passages to the lungs, is protected by its unbroken surface which is covered by cilia and mucus. The digestive tract is likewise protected by linings that are normally unbroken; furthermore the action of digestive juices destroys most of the bacteria. The genito-urinary tract is defended by unbroken tissue, by location, and by the outward movement of products. Nevertheless, infections can and do penetrate these defenses.

The route by which micro-organisms gain access to the body is called the portal of entry. As a rule, every disease has a specific portal of entry; for example cholera and dysentery enter the body through the digestive tract, malaria is introduced through the skin puncture made by Anopheline mosquitoes, pneumonia enters through the respiratory tract, tetanus enters through deep wounds. If the organism gets into the body by any channel other than its regular portal of entry, the disease will probably not develop. For example, tetanus bacilli may be harmless if swallowed along with food, yet may cause a deadly infection if they enter through a deep wound. Knowledge of the usual portal of entry of a disease is a valuable basis for control measures, since it aids in detecting the manner in which the disease is spread. For example, food or water would be suspected as agents for the spread of dysentery or cholera, since the digestive tract is the portal of entry for these diseases.

Some diseases, especially those of the respiratory tract may be spread by "droplet infection"; the organisms may be carried for short distances on droplets of moisture sprayed out by the sick person in sneezing, coughing, or loud talking. Diseases which are spread through droplet infection can be controlled to a large extent by personal care, such as the avoidance of sneezing or coughing close to another person. Covering

the mouth with a clean handkerchief is also good standard procedure. This should be called to the attention of any seaman who has a respiratory illness. Adequate ventilation of compartments, especially those which are crowded, is of general value in cutting down the spread of respiratory infections. Spacing of bunks in such a manner that the heads of the men are widely separated is also advisable.

Diseases may also be transmitted by direct body contact. Skin diseases and venereal diseases are most likely to be spread in this manner. The diseases which are spread through body contact can be avoided very largely through personal care. Cleanliness of the hands and clothing is obviously important. This is one of the reasons why good personal hygiene should be enforced throughout the entire ship.

Many diseases are spread from person to person by means of some intermediate object. In such cases, objects like towels, clothing, dishes, etc. may become contaminated by the sick individual and then be used by the well person who becomes the next victim of that disease. In addition to objects of this nature, water, milk, or food may also spread disease in a similar indirect fashion. Water, milk, and food are the vehicles of intestinal diseases such as typhoid, dysentery, or cholera. The excreta of the sick person usually contains great numbers of the causative organisms of the disease. Through improper sanitation, it is quite possible for these organisms to get into water, milk, or food, and thus infect the new victim. Here again, the Hospital Corpsman should be especially interested in the possibilities of spread of infections from the sick bay throughout the rest of the ship.

There are several different ways in which insects can spread disease. Some insects, such as the common fly, may act as mechanical carriers to transfer the micro-organisms from place to place. They may carry bacteria from the discharges of an ill person in the sick-bay into the galley and onto the food. Aboard ship, the fly will generally not be a nuisance while at sea, but in port flies may be quite prevalent, especially in warm areas and if the sanitary conditions are not satisfactory. Proper waste disposal, especially in the galley and heads, is of importance in preventing the presence of large numbers of flies.

Insects may spread disease by taking the bacteria into their bodies. Here in the insect's body, the bacteria multiply and great numbers may be deposited in the excreta of the insect. An example of this is the rat-flea which may pick up the plague bacillus from a person ill with bubonic plague or from an infected rat, and deposit many of these bacteria on the skin of the next person it bites. This person may rub the bacteria into the skin when he scratches the bitten area.

Since fleas are common on rats, and rats are commonly found aboard merchant ships, a potential danger exists. This is of particular importance when a ship is tied up at a plague port or has just departed from such a port.

A third type of insect transmission occurs when the micro-organisms develop and undergo part of their life-cycle in the insect. For example, the Anopheles mosquito may take up malaria organisms when it draws blood from a malaria victim. These organisms develop and mature in the mosquito, and find their way into the insect's saliva. When the mosquito bites another person, these organisms are injected as the mosquito deposits saliva in the puncture. A mosquito can endanger a merchant crew in several ways. When a ship pulls into ports where mosquito-borne diseases are prevalent, the men going ashore will be exposed; there is little that the Hospital Corpsman can do about this other than warning and educating the crew members, since the port sanitation is beyond the scope of the Hospital Corpsman. However the insects may also come aboard the ship, especially if the ship is docked or tied up close to shore and if prevailing winds are in the direction from shore to ship. Also, after a ship has pulled out of port, mosquitoes may breed aboard the ship in various fresh water containers; they have even been known to breed in the water jackets of machine guns.

A number of animal diseases can be spread directly to man. Probably the most familiar example of this is rabies, which may develop following the bite of a mad (rabid) dog. However, this is not likely to occur to the merchant seaman. One of the more likely possibilities on a merchant ship is "parrot fever" which can be spread by means of infected birds of the parrot family. Parrots are not safe pets for the sailor because of this danger, and are not permitted through quarantine except after special application procedures.

We have already seen how sick persons can spread disease, and how one who has a disease in the incubation stage may spread that disease even before his symptoms appear. Also, a person who is recovering from a disease may lose all symptoms and appear well, yet the organisms may still be present in some cases. Such an individual may therefore be termed a *convalescent carrier* until such time as he no longer spreads the organisms.

Another type is the *chronic carrier*. When the simple term "carrier" is used, it usually refers to this type. Such a carrier harbors the disease-producing micro-organisms, but shows no external signs of disease. He is particularly dangerous because other persons do not know of his condition, and even he himself may be unaware of it.

One of the best examples of a carrier condition is that of the chronic typhoid carrier. The typhoid bacilli are harbored in the body, and often are concentrated in the gall-bladder. Thus, as bile is secreted, the bacilli are poured into the intestine and pass out with the excreta. A typhoid carrier is very dangerous if employed as a food handler, since contamination of the food becomes a very likely possibility.

Physical examination of merchant seamen, especially of stewards and mess-men, may aid in eliminating such carriers of disease. It is possible, by laboratory tests, to discover typhoid carriers and in some cases the condition may be cleared up. Under no conditions should a typhoid carrier be permitted to work in the galley or mess hall.

HOW MICRO-ORGANISMS ARE CONTROLLED IN THE ENVIRONMENT

If the Hospital Corpsman is to control the spread of disease on his ship, he must know how to prevent the growth of micro-organisms and how to destroy them. Such knowledge will be very important in the sick-bay also, where infectious diseases must be handled and where contamination is a problem of utmost importance.

Several basic terms are used frequently in reference to the control of infectious agents:

1. The term *sterilization* is applied to the process of destroying all forms of living matter that may be present on or in the article or substance in question. When an object is completely sterile, there are no living forms present; (no plant or animal life, harmless or pathogenic, microscopic or larger).

2. *Disinfection* is the process of destroying infectious agents only; in this manner, infectious material is rendered harmless. However, harmless forms of living organisms may still be present. Thus disinfection is not as thorough as sterilization, but is concerned only with destroying the pathogenic micro-organisms.

3. A *germicide* is an agent, usually a chemical, which will destroy "germs", thus killing bacteria and other micro-organisms as well. This property is called "germicidal action". Germicides may be further divided into the following: bactericide, an agent which destroys bacteria; viricide, an agent which destroys viruses; fungicide, an agent which destroys fungi.

4. An *antiseptic* inhibits or prevents bacterial growth, i.e. prevents multiplication of bacteria. It does not necessarily kill the micro-organisms.

Most pathogenic micro-organisms require warmth, moisture, and food material for their maintenance and especially for their growth and reproduction. Under favorable conditions, bacteria may reproduce by division as rapidly as every 30 minutes. Thus, in a day or two of reproductive activity at this rate, huge numbers of bacteria result. On the other hand, adverse conditions retard the growth of bacteria or result in their destruction. High temperatures (for example, a temperature the boiling point of water) kill most bacteria. Refrigeration prevents the multiplication of bacteria but does not necessarily kill them. Drying kills many bacteria by removing the moisture they require for life. Also, many different chemical agents will destroy bacteria.

Fortunately, nature provides certain factors which prevent the rapid growth and multiplication of bacteria:

1. Bacteria may be killed by drying, or removal of moisture to such an extent that it falls below the amount required by bacteria. This is an effective method except for spore-formers which have considerable resistance and which may live for many months or years in a dry condition.

2. Sunlight exerts a lethal or killing effect on bacteria, although sufficient length and strength of exposure are needed. Sunlight and "airing" are often used, for example by placing bedding and clothing on the open deck in clear weather.

3. In nature, bacteria are scattered throughout great volumes of air, water, or soil. This is effective in reducing dangerous concentrations. This process of dilution is used at sea, where waste and sewage are emptied into the ocean; in ports where many ships are present, this may be more dangerous because the dilution is not so great and the harbor may be fouled by such discharges.

4. Filtration involves the removal of bacteria by "straining" or passage of a suspension through a porous material; this type of action occurs in nature as rain-water passes through soil and sand.

5. Evaporation and condensation: In this process, bacteria are for the most part left behind during the evaporation period. Evaporation of water from the earth's surface, and formation of rain-clouds exemplifies this process in nature. Complete evaporation will kill bacteria by drying.

6. Sedimentation: Bacteria in a liquid suspension will settle to the bottom where they may die gradually, although some bacteria will remain alive.

7. Bacteriophage: This is an agent capable of invading bacterial colonies and causing destruction of the bacteria. Bacteriophage can be

inactivated or destroyed by heat and other physical or chemical methods.

The Hindus have long regarded the Ganges as a sacred river, pure and undefiled. They believed that the water was safe in spite of great contamination with sewage and corpses of cholera victims. Curiously enough, they were partly correct, for investigation shows that cholera organisms die rapidly in Ganges water. Further investigation of the river water led to the discovery of bacteriophage which destroys the cholera organisms.

Bacteriophage has specificity of action, i.e., certain bacteriophage will destroy certain bacteria, but any one bacteriophage will not destroy any or all bacteria. Attempts have been made to use bacteriophage for therapeutic purposes in the body, to destroy the bacteria of infections.

8. Antibiosis: This is the antagonistic effect of one species of organism upon another species. It is a composite effect of many factors, such as struggle for food, production of wastes, etc. If many micro-organisms are placed together in a limited environment, certain of them will die out as others gain ascendancy. Experiments have been attempted for the control of harmful bacteria in the body by introduction of harmless organisms that might destroy the dangerous ones by antibiotic effect, although there has been only a limited degree of success in these studies.

Penicillin, a recent and effective discovery, is an outstanding example of the principle of antibiosis. *Penicillium notatum,* a mold, is cultivated in the laboratory, and from it is derived penicillin, a chemical which will destroy many kinds of bacteria. Laboratory workers had noted that Penicillium growing in bacterial cultures inhibited the growth of bacteria in the surrounding area. The use of penicillin is a modified form of antibiosis, since the chemical produced by the micro-organism (Penicillium) is used to destroy bacteria. It is more effective than the sulfa drugs in combating some infections.

Nature does not work alone to destroy micro-organisms; man has taken many of her weapons and modified them or amplified them to combat organisms harmful to the human. It is interesting to note that these man-made controls are based largely upon the natural factors described above.

It has already been pointed out that bacteria require certain temperatures for growth, and that excessively high temperatures may kill bacteria. Such a high temperature may be applied in several different manners. Boiling in water at sea level for even a few minutes will destroy many pathogenic bacteria. Boiling for 10 minutes destroys all pathogenic bacteria, except spore-formers. The length of time that a given substance should be exposed to a high temperature varies with

the particular substance and the purposes for which it is to be used. For some purposes, only the most dangerous pathogenic bacteria have to be destroyed, while for other purposes absolute sterility is needed.

Another form in which heat may be applied is steam. "Live steam" may be used for pipes, tanks, various containers, or other objects which require sterilization and which will not be damaged by steam. The Hospital Corpsman may well bear in mind the fact that steam is usually available on merchant ships and various methods for using this steam may be improvised.

There are other methods of using steam, but these require special equipment. For example a variety of pressure cooker called the autoclave uses steam under pressure in a sealed chamber. The autoclave is a common laboratory apparatus, frequently used in hospitals and sick-bays. Steam is forced into the chamber at 15 pounds pressure and a temperature of 121° Centigrade is attained; usually a period of 20 minutes is required for complete sterilization under these conditions.

Various forms of dry heat may also be used. Certain objects may be subjected to direct flame, provided that such treatment does not damage the object. Worthless objects which may have been contaminated (for example, through use by ill persons) can be disposed of by incineration to assure destruction of the micro-organisms. Hot air in an oven is also an effective method of sterilization for those objects which will not be scorched or damaged by the high temperature. A temperature of 160° to 170° Centigrade for one hour should be used.

Pasteurization is the process of heating a material to a sufficient temperature for a sufficient time to destroy pathogenic organisms without interfering with the quality of the material to be treated. This process is used for a number of food products, especially milk. This is not a sterilization process, since the temperature commonly used is 142° to 145° Fahrenheit. Most pathogenic bacteria are destroyed and thus the product is made safer for consumption.

Cold, even freezing temperature or below, does not usually kill all micro-organisms. Cold will generally inhibit growth and activity of micro-organisms. This explains the value of refrigeration and cold storage of foods. True, some bacteria will be killed, but others may simply remain dormant. If cold storage or other methods of refrigeration are used for preservation of foods, the specified temperature must be maintained constantly; otherwise, fluctuation of temperature to higher levels at intervals may permit micro-organisms to grow during each of these intervals.

In recent years, ultra-violet light has been popularized as a method

of sterilization. It is true that ultra-violet light will destroy bacteria, but carefully controlled conditions are necessary. In some cases the light is improperly used so that it is a mere frill which offers no protection but which looks very scientific to the layman. Usually, a rather long exposure and a direct exposure of the object to the light waves is necessary. The ultra-violet "sterilizers" used rather commonly on drinking-glasses in public eating places, are generally not satisfactory as a sterilizing agent. The glasses are usually stacked on rows of glass shelves with the ultra-violet lamp above; the light does not penetrate adequately through the many layers of glass, and glasses may be removed and replaced frequently. Ultra-violet light is also being used to "sterilize" drinking water; this requires expert supervision since the light rays do not penetrate far into the water, and turbidity in the water makes the ultra-violet light almost useless.

Drying is a very effective simple method for destroying bacteria. Many pathogenic bacteria will die quickly when a contaminated article becomes thoroughly dry. A combination of heat and drying is often a very effective measure to reduce the number of bacteria in the environment or on various objects.

Filtration of fluids through special filters can be used very effectively to remove bacteria. Special porcelain filters used in the laboratory are efficient. Commercial filters sold to "purify" drinking water should be regarded with apprehension, since many of them are intended to remove only large suspended matter such as dirt particles, and usually allow bacteria or other pathogenic micro-organisms to pass through.

Many chemicals are available as disinfectants or germicides. They are easy to use and are very effective in many cases. The Hospital Corpsman will find it practical to use such chemicals in the sick-bay, and to recommend their use in the galley and heads, and in various specific activities pertaining to general cleanliness on the ship.

WATER SUPPLIES

Almost every man aboard ship drinks water several times a day. He drinks this as it comes from the "scuttle-butt" or from containers. Unlike most other beverages or foods, water used for drinking does not undergo any further treatment or processing. The individual drinks the water as he receives it; there is not the additional protection of further treatment such as is applied to many food products which are cooked, boiled, fried, or otherwise treated. If bacteria are present in the water, the consumer swallows them "as is". This means that very careful selection of the original water supply is necessary, and great care is

needed to prevent subsequent contamination. Because of its wide use, it is apparent that contamination of the water supply may result in serious outbreak of disease that may affect most of the men on the ship.

Most merchant ships have several water storage tanks containing fresh water to be used for drinking purposes and for the boilers. The water to be used for drinking must be carefully protected. In some older ships, one side of the water tank is formed by the hull or deck of the ship and seepage of salt water from the outside sometimes occurs. This type of tank, known as a "skin tank", may present a danger to health if seepage occurs while the ship is in foul waters of a crowded and insanitary port. In newer ships this danger has been decreased by the use of electro-welded plates which do not ordinarily permit seepage. Nevertheless, it is recommended that each drinking-water tank be a complete sealed unit with separate walls ("detached tank").

The task of taking water into the vessel's supply tanks must be carefully supervised. This is the job of the engineer, who understands the mechanics involved and is cognizant of the applicable regulations. The Hospital Corpsman should also be aware of the correct procedures for taking on water, since there are disease dangers involved. The shore supply from which the ship's tanks are filled must be of known purity, as required by Federal Regulations. Such information can be obtained from the health officer of the particular port. In American ports, water should be purchased only from water boats which hold an unrepealed certificate of the United States Public Health Service. In the process of filling the tanks, special hose kept for this one purpose should be used; fire hose should not be used since it may have been contaminated through previous use of harbor water. The hose should not be allowed to drag through sea water, since it may become contaminated by foul harbor water or even by the sewage or waste discharges of the ship. To minimize such danger, it is desirable that the water boat be located away from the waste discharge area of the vessel receiving water.

Most modern merchant ships are equipped with evaporators and condensers which can be used to convert sea water into fresh water. The fresh water so obtained is frequently used for the boilers, but with proper care may also be used for drinking purposes. The process, called distillation, consists of boiling the sea water, collecting the steam and cooling this steam to form fresh water. The salts and any suspended matter are left behind in the evaporator. In this process, any dangerous bacteria are killed by the heat process and are left behind in the evaporator when the steam passes over into the condenser. If the still is functioning properly, the water will be safe for drinking. This is not

the usual routine procedure; drinking water is obtained almost invariably from the storage tanks filled in port. However, should the main water supply in the storage tanks be lost through damage, or become contaminated, it is possible to use the distilled water. Distilled water may taste "flat"; it can be rendered more palatable by cooling and aeration.

The distilled water, as well as the water in the storage tanks, should be free from salt. If salt is present, some fault in the system exists. The danger to health lies in the fact that bacteria may have entered into the fresh water supply at the same time that the salt water entered. The test for the presence of salt is a simple one. A clean glass, thoroughly washed in fresh water, is filled with the water to be tested; a crystal of silver nitrate or a few drops of silver nitrate solution is then added to this glass of water. Formation of a white chalky precipitate indicates the presence of salt.

The drinking water system must be completely separate from all other water-lines on the ship. Every ship contains a maze of piping to carry fresh water, salt water, waste, hot water, steam, and oil. To enable recognition of these different systems, each type of pipe may be painted a distinctive color. A cross-connection between fresh water and salt or between fresh water and waste can be extremely dangerous since it may result in the contamination of the drinking water. The engineers will check this frequently, especially after repairs have been made.

To conserve fresh water aboard ships, a system of "sanitary water" (sea water) is used for washing and scrubbing decks and for flushing toilets. The outlets should be clearly marked "unfit for drinking." Usually the outlets for the sanitary system are placed near the deck or in other locations where they are less likely to be confused with drinking water outlets. Water of standard lower than that of drinking water is not recommended for use in the galley for washing and cleaning. Wash water should be hot and followed by a very hot rinse or by steaming of the mess-gear and galley utensils. Seacocks for the intake of salt water should always be located so that the ship cannot take in her own discharged wastes. Sea water that is taken on while the ship is tied up at the dock or at anchor in a harbor should not be used for scrubbing decks in the galley or in any other space where food is prepared or stored. In general such water if used at all should be used exclusively for toilet facilities.

Drinking water should always be obtained from approved public sources. However, if conditions make it necessary to take on water of questionable quality, several possible methods are available to render

the water safe for consumption. Chemical treatment is very commonly used since it requires no elaborate equipment. Large scale water supplies used in cities and towns are usually subjected to sedimentation, filtration, and chemical treatment. Aboard ship the only practical way of treating large supplies of water is by the use of chemicals alone. The chemicals most commonly used for this purpose are chlorine compounds. Chlorinated lime is available aboard almost every merchant ship or can be purchased from chemical supply companies. If it is in a fresh unopened container it will contain at least 25% available chlorine. There are other chlorine compounds which contain a higher percentage of active chlorine; for example, H.T.H. (high test hypochlorite), C.C.H. (concentrated calcium hypochlorite), or Perchloron. These concentrated forms usually contain 60% to 70% available chlorine. All of these chlorine compounds deteriorate upon exposure to air and moisture. In addition to the above powdered preparations, solutions of sodium hypochlorite are available. The following chart indicates the amount of chlorine compound needed:

Per 1,000 gallons of water (4 tons), use:

Chlorinated Lime	1½ ounces
or	
H.T.H., or C.C.H., or Perchloron	½ ounce
or	
Sodium Hypochlorite, 1% solution	1 quart

The first step in the procedure known as "batch chlorination" is the determination of the amount of water, in terms of weight or volume. Then, the amount of chlorine compound required is calculated from the above chart. Note that the amount required is in proportion to the chlorine content of the substance; chlorinated lime has 25% available chlorine, while H.T.H. has 70%, hence the required amount of chlorinated lime is three times that of H.T.H.

After the proper amount of chlorine compound has been determined and measured out, a concentrated chlorine solution should be prepared to obtain adequate mixture. Powdered compounds should not be added directly to the water tanks. If chlorinated lime is used, the proper amount should be placed in a dry bucket; water is then added gradually with stirring to produce a thick paste. Continue to add water and mix until about two gallons of solution are obtained. This solution should stand at least one-half hour to allow sedimentation; decant the solution, discarding the sediment. This solution is now ready for introduction into the water tanks. If concentrated chlorine compounds such

as H.T.H. are used, a solution is prepared in the same manner, except for the fact that it is not necessary to allow for settling of undissolved material. If chlorine solutions such as sodium hypochlorite are used instead of powdered forms, obviously no preparation is necessary.

The chlorine solution is poured into the tank, and the water to be treated is then introduced. Whenever possible, place the solution in the tank first, because the addition of the water provides for adequate mixing. If it is necessary to add the chlorine solution as an emergency precaution for a tank already filled, re-circulation pumps may be used to aid in mixing the solution. The roll of the ship will aid the mixing process but alone is not sufficient. After mixing, at least a 30 minute period is required to assure action of the chlorine.

The amount of chemical added is sufficient to provide 2.5 parts per million of chlorine in the treated water. Some of this chlorine will be used up by combining with organic matter, including micro-organisms. The amount of chlorine used in such action depends largely upon the amount of organic matter in the particular water supply. If the water is free from organic material, most of the chlorine remains and a very distinct chlorine taste may be noticed. However, if the water contains considerable debris or other suspended matter, the chlorine will be depleted. It is desirable that chlorine still be present to the extent of 0.2 to 0.5 parts per million after completion of the treatment. This remaining chlorine, called "residual chlorine," not only indicates that the dosage of chlorine was sufficient, but also provides a certain degree of sustained protection against subsequent contamination of the water.

"Residual chlorine" may be measured after the 30 minute period of chlorine action. A very crude estimate may be obtained by tasting the water, or by shaking a sample in a jar covered by the palm of the hand and noting for odor of chlorine. More accurate measurement can be obtained by the addition of 20 drops of orthotolidine solution to a glassful of the treated water. A canary yellow color indicates proper residual chlorine concentration (approximately 0.5 parts per million); lighter color indicates insufficient chlorine, darker color indicates the presence of an excessive amount of chlorine. Standard orthotolidine test kits are available through commercial chemical companies.

If no residual chlorine is detected in the samples of treated water, additional chlorine should be added; introduce the same amount originally used, mix, allow 30 minutes and then re-test.

If a heavy excess of chlorine is noticed after at least 30 minutes, this may be removed by addition of sodium thiosulfate; usually ½ ounce of the latter per thousand gallons of water will be sufficient to remove excess chlorine.

Cleansing and disinfection of the water supply system should be performed periodically, preferably every three months. This is accomplished by scrubbing the tanks and flushing the lines. After scrubbing and flushing, a concentrated chlorine solution is placed in the tanks, using 20 times the quantity advocated above for regular chlorination of water. The tanks are then filled, yielding a solution containing chlorine in a concentration of 50 parts per million. All taps and faucets should be opened to allow this highly chlorinated water to enter the distribution lines. Then the taps should be closed and a period of at least 4 hours should be allowed for disinfecting action. The tanks and lines are then drained and filled with pure fresh water.

Occasions may arise when it becomes necessary to purify small quantities of water. Boiling is always useful, of course, for water in small containers; the water in the container should be boiled for 10 to 20 minutes. Hypochlorite, chlorinated lime, or other chlorine compounds may be used for emergency treatment of water, using proportions similar to those already described. The United States Army routinely uses one gram of calcium hypochlorite per 36 gallons of water. This, however, applies to field conditions where muddy and highly contaminated water is found; for fairly clean water, one gram of powder will be sufficient for 50 gallons. If neither heat nor chlorine compound is available, other chemicals can be used. Tincture of iodine is added in the proportion of 2 drops to a quart canteen of water. Potassium permanganate may also be substituted, using one gram per 36 gallons of water. In these cases, as before, the solution must be thoroughly mixed and allowed to stand for a half hour prior to use.

Since so much effort goes into the maintenance of a safe water supply, care should also be taken at the final step, namely, the individual consumption of water. The ordinary scuttle-butt provides a fair method of dispensing the water but is subject to certain objections. Splashing may occur and transmit infection to the mouth or eyes of the user. This is most likely to occur if other men insist upon using the scuttlebutt as a spittoon. Men should be directed never to spit in the scuttlebutt or to throw trash into it. The individual should also be warned not to mouth the bubbler, but to keep his lips and face as far away as possible. The best type of dispenser now available produces a strong splashless stream of water and is operated by foot treadle. If an individual container such as a cup or can is used, it should not be used by different persons. Individual single-use paper containers are very desirable; other types of containers should be thoroughly washed before use.

Sanitary dispensers for salt tablets may be located near the scuttlebutt. These are intended for the use of seamen who are exposed to high temperatures, for example men in the engine room. Exposure to high temperature causes sweating and loss of body salts thereby. This may result in nausea or heat exhaustion which may be prevented by the use of salt tablets.

Ice placed into beverages must be of known purity, such as ice prepared by mechanical refrigeration of drinking water or obtained from approved shore sources. Cooling systems are least likely to contaminate water, since the latter passes through a system of sealed copper coils; these coils are kept cold either by mechanical refrigeration or by ice packed around the coils.

Sailors will do well to remember that the water supplies in many ports throughout the world are not up to proper sanitary standards. In some ports, diseases like dysentery, cholera, or typhoid may be lurking in the water. Although some sailors may boast of never touching a drop of water while on leave in port, most men run the risk of picking up water-borne diseases. Remember that boiling destroys germs, and that most restaurants or eating places supply boiled water in the form of coffee or tea. This does not offer perfect protection, since utensils may be contaminated, but it does increase the margin of safety. For the same reason it is suggested that all foods be cooked thoroughly.

Usually the ship's master will not permit men ashore in areas where severe water-borne epidemics exist. However, in any ports where intestinal or other water-borne diseases are prevalent, it is wise to remain aboard the ship. Although this is sound advice, it will not always be followed; therefore, as a second-best suggestion, men should be advised to have their meals and water aboard ship, and to avoid insanitary restaurants or eating places ashore. Such advice is particularly valuable in ports where cholera or dysentery is present, as in various ports in the Orient. A relatively large number of merchant seamen have contracted intestinal diseases during World War II. This might have been avoided if the proper advice had been available and had been followed.

The simplest way to detect an outbreak of water-borne disease aboard ship is to notice carefully the number and distribution of cases. If a disease is spread through contamination of the main water supply, many men will become ill at the same time, and these men will come from all divisions of the ship. The disease will not be confined to any particular group, but will be spread uniformly. Certain of the men who drink the water may not develop the disease, because of good

resistance, or immunity, or because they did not drink very much of the water. Usually the outbreak will occur soon after the water has become contaminated. In general, pathogenic bacteria die out very quickly in fresh water; if they do not die, they at least become much weaker and lose their virulence so that they become less harmful. As soon as the cause of a water-borne epidemic is discovered and removed, the outbreak will quickly die down and no new cases will appear unless new contamination occurs.

The outstanding diseases which are transmitted by water are intestinal diseases, including typhoid, paratyphoid, amoebic dysentery, bacillary dysentery, and cholera. These are all serious diseases which may result in deaths should an outbreak occur. In addition to these severe diseases there are a number of less dangerous non-specific disturbances such as diarrhea or other gastro-intestinal upsets. These non-specific intestinal illnesses may be due to a variety of micro-organisms, or may be due in some cases to chemical pollution of the water.

FOOD AND GALLEY SANITATION

The principles of sanitation followed for galley management are essentially the same as those followed in any other food dispensing or food processing establishment. The most important principle is the maintenance of a system of cleanliness and orderliness, enforced at all times. In order to establish such a system which will operate smoothly, it is necessary to emphasize certain factors. The personnel who handle the food must be in good health and must be clean. The galley itself, and the equipment contained therein, must be kept clean by constant effort. Immediately after each meal, the dishes and utensils must be properly cleaned and safely stored. The food itself must be clean to begin with, and must be handled and prepared in a sanitary manner.

The subject of food sanitation is presented in some detail because the Hospital Corpsman is likely to encounter serious outbreaks of food infections and food poisoning. It will not be sufficient to merely treat each patient, but it will be necessary to track down the source of the outbreak and to remedy the conditions causing it. Even if the particular outbreak dies down of its own accord, there is a great chance that the same type of trouble will occur again and again unless the source is found and the condition is corrected.

It is realized that the Hospital Corpsman has no direct jurisdiction over the galley or the messmen, and that he may encounter resistance to his suggestions for sanitary and hygienic standards. His approach should be educational rather than critical, and he should stress his

interest in the health of the crew as the purpose of his activities. A carelessly critical attitude on his part may thwart the achievement of any program for sanitary improvement; he must "sell" his ideas and suggestions to the other officers and to the crew.

All food handlers receive a physical examination at the time of sign-on. Special attention should be given this group of men, since diseases arising from infected galley hands can lead to serious outbreaks aboard ship. Such an examination will indicate that the seaman accepted as galley hand or messman is free from infectious diseases. The most serious of these are intestinal disease and skin infection. The venereal diseases are important if they are present in the infectious stages.

The sign-on medical examination is a great aid, but it by no means affords complete protection against the presence of disease among the galley crew. At the time of sign-on, a seaman may have a disease in the incubation stage, and may not show any external symptoms until at sea. Men in good health may go on shore leave or liberty in various ports and contract disease. A cholera or dysentery case among food handlers may develop in this manner in foreign areas, and the Hospital Corpsman may be the only man on the ship who can find and handle the condition. Any man among galley hands or messmen who shows signs of undiagnosed intestinal disease (as evidenced by diarrhea, vomiting, or related symptoms) should be relieved of food handling duties during the period of his illness. If the condition clears very quickly, it may be nothing more than a transitory gastro-intestinal disturbance; if it persists or grows worse, it may be a serious communicable disease.

A "pier jumper" who signs on at the last minute, just before the ship sails, should not be assigned to work with food until he has had a thorough physical examination. He may be regarded with suspicion, since he may be using this technique for evading the routine sign-on examination. Similar care should be taken with seamen who sign on at foreign ports to replace men who have "jumped ship" or to fill other gaps in ship's complement.

The Hospital Corpsman should keep a weather-eye open for the appearance of any case of infectious disease among the galley crew. He may make it a practice to notice these men every day, and to recommend their removal from food handling work if any symptoms of communicable disease appear. It is also advisable for him to notice the general cleanliness of the food handlers, noting especially the conditions of clothing, hands, and fingernails. It is not only unpleasant, but also decidedely unsafe to allow men with dirty hands to handle and prepare

foods. It may be advisable to work out a set of standards or regulations pertaining to galley sanitation and personal cleanliness in the galley; this can be accomplished through the cooperation of the officers in charge of mess and commissary. Some provision may be made to educate the galley hands and messmen in the basic principles of cleanliness and sanitation in the handling of foods.

The equipment installed in the galleys on many vessels requires considerable attention from a standpoint of sanitation. Often, spaces are left between fixtures and bulkheads or between fixtures and the deck. These spaces are too small to provide room for easy cleaning, yet are large enough to receive food scraps, broken glass and other debris. Such accumulations of scraps serve as a source of food and harborage for rats and insects. One of the biggest sanitary problems aboard ship is the control of rats which can spread disease. Cockroaches are also nuisances which indicate insanitary conditions and may be involved in transmission of disease. Neither the rat nor the roach can exist without food, and scrap accumulations in the galley may serve as food and shelter for these vermin. Although perhaps little can be done to replace and modernize old equipment, nevertheless careful management and cleanliness can prevent filthy conditions that allow vermin to breed. Regular inspections of galley and storerooms will aid in the detection and elimination of such conditions. Accumulated waste, especially grease and fat, are not only insanitary but are fire and safety hazards as well.

A galley that is properly equipped will have all working surfaces made of smooth non-porous material which can be cleaned easily. In general, corners and edges are rounded for easy cleaning. Metal utensils and machinery should be made of non-rusting material. Good lighting is an aid to cleanliness and to careful preparation of food. The bulkheads in the galley should be of moisture-proof composition, or coated with a hard surfaced material which is light in color and easily cleaned. The ceiling is to be kept free from any peeling paint or other material which might drop into the food. The deck should be of non-porous composition which can easily be cleaned and which will not soak up spilled foods. Usually the deck slopes toward the drains, so that swabbing with plenty of water can be accomplished easily. The deck should be cleaned very thoroughly once a day and preferably after each meal has been prepared. Food scraps should be removed from the deck as quickly as possible for reasons of safety (slipping or other accidents) as well as for proper sanitation.

Several insanitary aspects of garbage disposal occur frequently. Too

often, waste is heaped above the top of the container so that the garbage spills over the sides and soils the deck. Also, fluid and solid waste should be separated so that the contents of the can will not become a foul semi-fluid mass of decomposing garbage. Separation can be accomplished by using individual containers, one for fluid waste and one for solid waste. An alternate method is the use of a wire basket or strainer in the upper half of the can so that the fluid will trickle through while the solids remain in the upper portion. Garbage and general refuse should not be stored in the galley, but should be kept in a separate compartment. This becomes more important during a war period when garbage must be stored during the day-light hours. Garbage should be placed immediately into covered cans in this separate compartment, to be stored until nightfall. A garbage can should be cleaned each time it is emptied.

Convenient toilet facilities are essential to permit the food handlers to wash their hands frequently. The head used by food handlers should not open directly on the galley since this permits too ready access and may lead to carelessness. If the head is so located that it does open into the galley, it should be equipped with a vestibule structure and self-closing door. Galley hands must pay particular attention to the need for thorough washing after using the head. Plenty of good soap and individual clean towels are to be provided. After use of the head, hands should be washed there; a food handler should not come back to wash his hands in the galley since he may spread germs onto food and gear before he washes.

FOOD-BORNE INFECTION AND FOOD POISONING

The fact that infections can be spread through food has already been mentioned, but the Hospital Corpsman should have a more thorough understanding, and should know some of the specific diseases that may be transmitted in this manner. The food-borne diseases can be placed in several major groups; those of bacterial origin, those caused by protozoa, and the worm infestations, plus several types of food poisoning.

Typhoid fever is frequently spread through direct or indirect contamination of food by fecal material from typhoid cases or carriers. Typhoid organisms also get onto food through washing with contaminated water. Shellfish, such as oysters and clams, may be contaminated with typhoid bacteria present in the water in which the shellfish live; shellfish taken from the water surrounding large cities or ports are dangerous for this reason. Serious epidemics of typhoid fever have been traced to this type of occurrence. Another manner in which oysters

and clams become contaminated may take place when the shellfish are brought in from the ocean for storage; frequently, the dealer places them in fresh water to keep them cold and alive, and to allow them to swell by absorbing water. In this procedure, the fresh water is frequently that of a creek or small inlet which is seriously contaminated. The lesson to be learned from this knowledge is to avoid eating any type of shellfish raw unless the source and handling are safe beyond question.

In many parts of the world, especially in Asiatic countries, foods are grown in soil fertilized by human excreta. Such foods, when brought to market, may contain the causative organisms of typhoid, paratyphoid, cholera, dysentery, or other intestinal diseases. This is mostly likely to occur in areas where these diseases are endemic (always prevalent) or epidemic. Celery, lettuce, or other vegetables or fruits that are consumed raw are obviously dangerous in these areas. Such conditions are contributory factors to the high rate of intestinal diseases in Asia and the Orient. From the knowledge already gained, the Hospital Corpsman should know how to cope with such a situation to protect himself and his crew members through proper precautions regarding food and water.

It is also possible for typhoid to be transmitted through the medium of insects such as the fly which may light on excreta of typhoid victims or carriers and then walk over food. Rats have also been known to transmit typhoid by carrying the organisms in their intestinal tracts and subsequently dropping their excreta into food. Both of these methods of disease transmission are discussed more fully in the section on insects and rats.

It is common belief that food products are most dangerous when they show evidence of decay or are "tainted." A food which is "tainted" contains considerable bacterial growth which indicates poor conditions of storage and treatment. Decomposition, unpleasant odor, and unpleasant taste may be noted. Such poor quality food is dangerous not because of the fact of decay itself, but rather because this decay indicates poor handling which may result in serious contamination with pathogenic micro-organisms. This is the most important reason why unwholesome-looking food is rejected. Nevertheless, it is quite possible for food to be heavily laden with dangerous bacteria and yet show no gross changes. Therefore, measures which protect food against contamination are very necessary. These measures include laws and sanitary supervision of food distribution and processing, physical examination of food handlers and education in regard to habits of food preparation and consumption.

Amoebic dysentery is an intestinal disease caused by the protozoan known as Endamoeba histolytica. This organism can be spread through

water or food. Its mode of spread by food is similar to the methods already discussed concerning the contamination of food by bacteria. Control measures are likewise similar to those described for the control of bacterial food-borne infections.

A number of diseases are caused by larger parasites such as worms, which may be present in food products. Usually meat is the vehicle for such organisms. Most people are familiar with the pork tapeworm. This is a long segmented worm commonly transmitted by under-cooked pork or pork products. Similar tapeworms can be transmitted through beef and through fish. When such foods containing the immature forms of tapeworm are eaten by man, the worms may develop and live within the human intestinal tract.

The tapeworm problem can be prevented to a large extent by proper disposal of human excreta to prevent it from entering the food of animals. Tapeworm segments and eggs from a human case of pork or beef tapeworm pass out of the body with the human excreta. These segments and eggs may be eaten accidentally by hogs or cattle, resulting in diseased animals. When meat from these diseased animals is consumed by humans, the tapeworm embryos enter the intestine and mature. Preventive measures to curb the incidence of human infestation include thorough cooking of all meat, and inspection of meat from hogs and cattle. Cold storage of meat for several weeks tends to destroy many of the tapeworms, but by itself cannot be relied upon to remove the danger.

Anothere type of worm commonly found in meat is the trichina, a small roundworm. The encysted larvae (immature worms) of this form have been found in about 2% of pork in the United States and the incidence is probably much higher in other areas. When the meat is eaten, the encysted larvae of the worm enter the human intestine where they are liberated from their cysts, and reproduce. This reproduction results in the formation of numerous larvae which penetrate the intestine and enter the blood stream. The blood carries these larvae to the skeletal muscles of the body; the muscles of the diaphragm are also a common location for these worms. In the muscle tissue, the embedded worms become surrounded by a cyst produced by the tissue as a defense mechanism to block off the worm. From autopsies it has been estimated that as much as 25% of the general population of the United States may have these cysts present. However, most of the cases are mild and only a small percentage show actual clinical symptoms of disease. The severity of the particular case depends upon the number of worms which invade the body.

Trichinosis is also best prevented by thorough cooking of all pork and pork products. It is possible to examine pork microscopically for the presence of these worms, but such inspection is difficult and inaccurate. Infested pork comes almost entirely from garbage-fed hogs; if the latter practice were to be eliminated, or if all garbage fed to hogs was cooked to destroy such worms, the incidence of the disease could be reduced markedly.

In addition to the above mentioned food-borne infections and infestations, other illnesses may result from food. Food poisoning may result from a variety of chemical substances in foods; such substances may be present naturally in certain foods, may be introduced accidentally, or may develop in some foods as the result of bacterial growth. The illness resulting from food poisoning may be very severe or may be very slight, with many intermediate degrees. The proportion of deaths as compared with the number of cases is very low. Outbreaks of food poisoning are usually described as "explosive," because most of the cases occur at the very same time; most of the people who have eaten that particular food product will be severely ill, yet a few days later most of them will be back to normal.

Some items consumed as food may contain substances which are poisonous to the human being. A familiar example of this may be found in certain types of mushroom. There are also a number of other foods which exert milder poisoning effects upon the body.

Foods may be also be poisoned accidentally through careless management. There have been many instances where roach powders or rat poisons were introduced into food through the use of unlabeled containers or failure to read labels. There are many other types of accidental introduction of poisons which may occur. Certain sprays used in cultivation of fruits contain poisonous compounds or other highly toxic substances. One such poison is hydrogen cyanide, a deadly gas sometimes used for disinfection of dried fruits.

It is also known that certain bacteria will grow on food products and produce dangerous toxins or poisonous substances as the by-product of their growth. Poor sanitary conditions usually account for the introduction of such bacteria into the food; poor storage such as inadequate refrigeration, or presence of moisture and poor ventilation, are factors which permit the further growth of these bacteria. Some staphylococci, capable of producing toxic substances, have been associated with this type of food poisoning. Starchy foods such as the fillings of eclairs and cream puffs or other custards are outstanding examples. Improper sanitary handling, improper cooking, and inadequate refrigeration are

the chief contributory factors. A case of food poisoning resulting in this manner is usually manifested within six hours after the time the food is eaten and the duration of the illness is usually one or two days. There are relatively few fatalities from this cause, although serious and debilitating illness may occur.

Another food poisoning resulting from bacterial action in food is botulism. The bacterium involved is a spore-forming bacillus which grows in the absence of air. This organism is harmless in itself, but when it gets into food products where no air is present, it produces a deadly toxin. The greatest source of danger of botulism lies in canned goods, because canned products are sealed and practically no air is present in the can. The botulism bacillus, being a spore-former, is not easily destroyed by heat. Thus, if canned food is not thoroughly heated under proper processing conditions for canning, some of these spores may be present and may grow in the food to produce poisonous by-products. Commercial canneries are usually well supervised to prevent such an occurence, but home-canned foods may be dangerous because of the absence of good technical control. The poisonous substance produced by the botulism organism is very powerful, and the case-fatality rate is very high.

When food products decompose, starches and sugars undergo a fermentation process and proteins break down by "putrefaction." Much of the foul odor associated with decayed food is due to the putrefaction of proteins. Some of the breakdown products of putrefaction are called "ptomaines," which are malodorous products of bacterial action. Foods in this condition are usually not eaten because of unpleasant appearance and odor. However, as far as we know at present, most of these ptomaines are harmless. In the past, many gastro-intestinal disturbances have been called "ptomaine poisoning." Generally this is not correct. Most illnesses called "ptomaine poisoning" are actually due to other causes. The real danger inherent in decayed food is the fact that decay indicates improper care; if the food decays, it has been exposed to conditions which have permitted rapid bacterial growth; if contamination with pathogenic bacteria did occur, great numbers may be present.

Food adulteration refers to some type of treatment which renders food dangerous or less valuable for human consumption. Sometimes deliberate adulteration of food is performed for economic reasons. The subject is important because such treatment may present a menace to health. A food is considered adulterated if any poisonous substance has been added to it; the particular factor here is the use of preservatives which may be injurious to health. A food is also considered adulterated

if it is decomposed, contaminated with filth, or comes from a diseased animal. Careful inspection and supervision of milk and meat products are performed to detect these conditions. Sometimes a valuable constituent is absent from food, for example the vitamin content may be lower than that stated by the producer. Sometimes efforts are made to conceal damaged or inferior products. Poor dyes are used in cheap products and may be harmful to the consumer. Any or all of the above factors may justify the condemnation of the particular food involved as "adulterated."

It has long been known that a particular individual may suffer severe disturbances from certain food. It is said that this individual has a hypersensitivity to such food. After eating the particular food to which he is sensitive, the individual may develop gastro-intestinal disorders, skin eruptions, or other symptoms referred to as allergic responses. Such a condition may be inherent in the person or may appear during some phase of his lifetime. The seaman who is bothered by such allergies can consult shore medical officials at his earliest convenience.

The Hospital Corpsman will encounter a number of acute digestive disturbances which may be due to careless or improper eating on the part of the individual. On certain occasions, a man may bolt his food and a short time later may suffer severe distress and vomiting. It is also possible that he may eat an extreme quantity of food at one meal, and that he may eat a vicious combination of unpalatable food. Such cases are temporary and will take care of themselves without much attention. The symptoms, however, may be mistaken for those of food poisoning. Probably the simplest way to distinguish between overindulgence and food poisoning is to note the number of cases. Food poisoning usually results in an outbreak involving a group of people, whereas overindulgence is usually an individual case or limited to a very small group of men.

WASTE DISPOSAL ON SHIPS

At first glance the problem of waste disposal on a ship may seem very simple. The ship at sea is surrounded by countless miles of ocean which can receive all of the waste products of the ship without any harm resulting. However, there is the problem of handling the waste aboard the ship, and the provision of systematic methods for safe removal of the waste. Also, of course, the procedure of waste disposal in ports and harbors presents certain problems.

In general, the wastes aboard a ship may be divided into two major groups: the liquid wastes, (sewage, bilge water, ballast water, oil) and

the solid wastes, (garbage, rubbish). The disposal of these wastes must be handled efficiently to avoid the creation of a nuisance, to avoid the formation of a breeding ground for rats and insects, and to prevent the spread of disease.

Sewage is a mixture of water, soap, urine, feces and various other fluid or semifluid wastes. Many bacteria may be present; most of these will be harmless, but pathogenic bacteria may be present as the result of the presence of body washings, secretions, and excreta. Sewage is collected and discharged from the ship through a system of pipes which may be flushed by salt water. The chief problem of sewage disposal is to avoid contamination of water, of food, or of other objects, since such contamination might result in the spread of disease. If any leakage of sewage or any cross-connection with fresh water supplies occurs, contamination will result. Thus, the piping system should be intact and leakproof at all times, and the flow should be sufficiently free to prevent overflow or backflow of sewage. Obviously, the "head" itself must be kept clean by means of daily scrubbing and swabbing, preferably with the use of a disinfectant. Soap, paper, and towels must be kept in good order. Too frequently, the head becomes dirty through neglect, for example through the failure to provide receptacles for waste paper or through failure to provide soap in suitable containers.

Other liquid wastes also require some concern. Bilge water may be contaminated, and should not be discharged in restricted areas. Such discharges might endanger bathing beaches, shellfish areas, or harbor waters. The same applies to ballast water, unless it was of drinking water quality when taken on and protected against contamination while carried. Discharge of waste oil must comply with ordinances, to prevent fouling waters in restricted areas and to avoid fire hazard. Over-board water used for swabbing decks creates no disposal problems since it drains directly overboard through the scuppers.

The theory of garbage disposal on a ship is very easy to understand, but in actual practice many annoying problems arise. Most of these are due to carelessness or to the lack of a rigid system. Garbage should be collected in metal containers only; these containers should be equipped with tight-fitting covers. The containers should be rat-proof and leak-proof. Solid and liquid garbage should be separated and kept in separate containers; all solids should be thrown into one can and all liquid or semi-liquid waste into another. Otherwise a strainer should be placed in the can so that the fluids will filter through to the bottom of the can. The can should not become too full, to avoid the overflow

of contents and to prevent the spilling of contents when the can is carried. The cans must be cleaned and scrubbed frequently to prevent fouling; a disinfectant may be useful.

Filled garbage cans should not be allowed to accumulate in the galley. As soon as one can is three-quarters full, it should be covered, removed, and replaced by a clean empty can. During ordinary times, the garbage is simply dumped overboard whenever a few cans are filled. This can be done only at sea, not in the water of a harbor.

Wartime regulations specify that no garbage shall be dumped from a ship at sea during daylight hours. The purpose of this is to avoid leaving a trail. Garbage must be held on the ship until darkness, at which time all garbage should be dumped. Whenever possible, the garbage should be made sinkable; bottles should be broken. These regulations make sanitary garbage disposal more important, since the garbage must be stored for as long as a day.

Port sanitary regulations usually prohibit the dumping of garbage into harbor water, to prevent the development of unpleasant and insanitary conditions. These regulations are often enforced by means of fines. It is very common for merchant ships to simply store the garbage aboard ship while at anchor or tied up at the pier. This is very undesirable, because the garbage usually becomes malodorous, attracts flies from shore, and may serve as a breeding place for flies and other insects. Also, the accumulation of garbage often interferes with the ship's activtities such as inspections, unloading or loading of cargo, and may interfere with repair jobs being done on the ship at that port. In port, extreme cases have been noted where mountains of garbage accumulate on the deck awaiting such time as the ship sails. The reason for this is either carelessness or because all garbage cans are already full. The answer to this problem is a request to the port sanitary authorities for the removal of the garbage. In some ports, the sanitation department will send a truck to the pier and haul away the garbage at slight cost. The cost is negligible as compared with the difficulties encountered by such accumulations of garbage. A special permit may be needed for the removal of garbage from ship, because if ship's garbage is fed to animals, diseases such as hoof and mouth disease may be introduced into the country. In United States ports, a permit must be obtained from the Department of Agriculture.

The best permanent answer to the problem of garbage disposal in port lies in the arrangement of routine facilities by the shipping company at its own pier. Such facilities may be either the provision of an

incinerator near the piers, or obtaining a permit and setting up an established routine to have the garbage hauled away.

Another satisfactory method of handling garbage is used on certain vessels which have a permanent garbage chamber built within the hull of the ship. Garbage enters this storage chamber via a chute from the galley, and remains in the chamber until a port is opened to dump the garbage at sea. If the chute and chamber are properly constructed and are cleaned periodically, the system is effective; it is a possible answer to the problem of garbage in port, since garbage may be stored for longer periods in such chambers without creating insanitary and troublesome conditions. Flushing and cleaning such a system is simpler and more effective than is the case when many cans and containers are used.

MARITIME QUARANTINE

Quarantine refers to the detention and segregation of exposed susceptibles, persons exposed recently to dangerous communicable disease but who do not show signs of illness. These persons are placed in quarantine because they may have the disease in the concealed incubation stages; even in these stages, the disease can be spread. Such persons, held under quarantine restrictions, are kept separate and observed for slightly longer than the incubation period. During this detention, the quarantined individual is restricted in his activities. This is done so that, should he have the disease, he cannot spread it to others. The period of time for such quarantine restrictions is determined by the length of the incubation period of the particular disease. It is important to distinguish between isolation and quarantine. When a person is noticeably ill with a contagious disease, he may be kept separate from other persons to avoid the transfer of that disease to new victims who are susceptible to the disease. This process of segregation of *ill* persons is called *isolation*. "Carriers" may also be subjected to isolation or partial isolation for the same reasons.

Maritime quarantine has been, traditionally, the procedure of limiting the freedom of movement of persons or animals aboard ship who have been exposed to certain communicable diseases, plus such other restrictions as may be needed to prevent the entry of a communicable disease into the port. This procedure is intended to act as a sieve at all ports of a country, to allow movement of normal travel and trade but nevertheless to screen out and prevent the entry of serious communicable diseases. In recent years the trend has changed, so that maritime quarantine is becoming less negative in nature. It is no longer

based solely upon restrictions and denials. Instead, it is attempting to offer constructive suggestions to eliminate the need for quarantine restrictions. Rather than detain a ship in quarantine or require a fumigation, the officials prefer to eliminate the causative factors that create such a need. They wish to see ships built with complete rat-proof construction, and maintained in good sanitary condition.

When a merchant ship enters a United States port, a Quarantine Officer may board the vessel. If the Purser-Hospital Corpsman on the vessel in question has been granted the responsibility of participating in quarantine procedeure, he should stand by and be ready to play his part in the procedure to qualify his ship for entry into the port. In most instances, the Purser-Hospital Corpsman will be asked to receive the Quarantine Officer and to provide him with the necessary information. To avoid over-crowding and confusion, it may be desirable for the work of the Quarantine Officer to be removed to the saloon. If the saloon is to be used, a check should be made beforehand to see that it is in good order. The Quarantine Officer will want to work with the Purser-Hospital Corpsman, to review the necessary ship's papers and to examine any ill crew members. For this reason, it is important that the Purser-Hospital Corpsman have his papers and records in order. A description of these papers and procedures will be found in the following paragraphs. The efficient Purser-Hospital Corpsman can be of great aid to the Master and Quarantine Officer, and may facilitate the entire procedure. The combination of duties as purser and hospital corpsman vested in one man is very valuable at this point, since this one man possesses a knowledge of the ship's papers and of disease and ship sanitation as well. The exact determination of his position will depend upon the orders of the particular Master. Although some variation in details of procedures may occur on different vessels and in different ports, certain general methods are applicable to all. This text covers such general procedures, but with the realization that minor variations may occur in specific instances.

One duty of the Quarantine Official is to detect cases of disease that might menace the public health of the port. Even a single case of a serious disease may result in the introduction of that disease into the country. Thus, the Purser-Hospital Corpsman should deliver a frank and honest account of all illness during the voyage. Since he will not be sure of his diagnosis of the disease, he should present the history and conditions of the case; this will be of aid to the Quarantine Officer in finding cases and recognizing the symptoms. It is likely that the Quarantine Officer will wish to observe with particular care those men

who have been logged as ill during the voyage. This is one of several reasons why *accurate written records* of illnesses and treatments must be maintained throughout the voyage. A neat, orderly, and scientific sick-bay log book will be much appreciated by the quarantine physician.

For such cases as appear to be serious communicable disease, the Hospital Corpsman should indicate what precautions have been taken to check the spread of the disease. He should indicate if and when the patient was isolated, and record other control measures. This will aid the quarantine physician in locating contacts and determining the degree to which the disease may have been spread among other crew members. If the Corpsman has carried out good isolation technique, the passage of the vessel and crew through quarantine may be speeded.

The Deratization or Deratization-Exemption Certificate indicates the extent of rat infestation at the time of issuance of the certificate. The form iself has a double caption, as indicated below:

"DERATIZATION CERTIFICATE
DERATIZATION EXEMPTION CERTIFICATE"

The Quarantine Officials will inspect the ship and fill out this certificate on the basis of an inspection for rats. If conditions indicate that no rats or only a very few rats are present, the heading "DERATIZATION CERTIFICATE" will be crossed out, and the document thus becomes an official "DERATIZATION EXEMPTION CERTIFICATE." If, on the other hand, considerable evidence of rats is found on the ships, she will be held for fumigation. Following fumigation, the vessel will be given the form headed "DERATIZATION CERTIFICATE" to indicate the time, place, and method used for destroying the rats.

The Deratization (or Exemption) Certificate should be kept as long as it is valid (usually 6 months) and be made available for inspection by the Quarantine Officers at subsequent ports of call. If such a certificate is obtained in a foreign port, it should be countersigned by the office of the American consulate at that port. These certificates deal entirely with the problem of rats, but they may serve as a general sanitary index for the vessel; a ship which repeatedly obtains exemption certificates year after year is probably clean and rat-proof while a ship which requires deratization (fumigation) again and again will be under suspicion as insanitary. The certificates are also useful as a guide for rat control, because the form filled out by the sanitary inspector indicates where rats are located, and the estimated numbers in different compartments. Such information may be used to determine where traps should be set and where a clean-up campaign should be centered.

The Quarantine Declaration is a form which contains most of the data and information needed by the Quarantine Officer before the ship can be cleared through quarantine. It includes a statement of the ports of call on the voyage, a record of illnesses en route, and other data on the ship's record. The Purser-Hospital Corpsman should prepare this information in advance, so that he will not have to scurry about at the last minute. The Purser should keep a store of extra declaration forms, and may fill in certain items prior to arrival in port. These spare forms may be obtained prior to departure from any American port, and a supply should be kept on hand by the Purser. When a ship pulls in for quarantine inspection, the Quarantine Officer will check the data in these items, and will complete the remaining items.

It is urged by the United States Public Health Service that every ship carry a Sanitary Log. Special forms for this purpose are available upon application to the United States Quarantine Station, Rosebank, Staten Island, New York (ask for Form No. 9452). Such a log book has been placed aboard all ships owned by, or under charter to the War Shipping Administration.

The purpose of the Sanitary Log is to provide a complete written record of the sanitary history of the ship. The log is of particular value to quarantine officers, and may facilitate quarantine clearance. "A vessel presenting a satisfactory sanitary history extending over a period of six months, as evidenced by completed inspection entries in the log, the last of which was made within 60 days prior to arrival at a United States port, may receive special consideration. In the discretion of the Quarantine Officer the vessel may be released from quarantine treatment without remand, upon the basis of a confirmatory preliminary inspection." The Sanitary Log presents a method by means of which the Quarantine Officers of one port will have authentic information on conditions and activities at previous ports of call. Since the log traces the sanitary history of the vessel, it serves to indicate the points of greatest constant trouble, shows what corrective measures have been applied, and demonstrates the relative effectiveness of such measures.

After the quarantine representatives have examined the ship's records and reviewed the medical and sanitary history of the vessel, they may issue a certificate of discharge from quarantine. This document is referred to as a Pratique, and permits the vessel to establish contact with shore for the first time following arrival. A pratique is issued only after the Quarantine Officials are assured that the establishment of such shore contact will not be dangerous to the public health of that port. A ship will be detained in quarantine, flying the yellow flag

(International Code "Q") until such time as a pratique is granted. This document is one of the necessary papers, without which the ship cannot make formal entry into the port. If a ship has met all quarantine requirements satisfactorily, she will receive a *free pratique* which amounts to a total release from quarantine with no restrictions. On the other hand, certain conditions may exist which require special consideration but which do not necessitate detention in quarantine. In such circumstances, a *provisional pratique* may be issued in lieu of the free pratique, outlining certain restrictions or special conditions to be observed in port.

In peacetime, *radio pratique* may be granted by some of the United States quarantine stations to certain vessels plying a routine course. Radio contacts are made prior to arrival. Such ships, to obtain radio pratique, must fulfill certain requirements, including the maintenance of high sanitary standards and freedom from cases of serious communicable disease. A modified form of quarantine inspection is required after the ship docks, but considerable time is saved.

RODENT CONTROL

Rats have been associated with ships throughout all maritime history, and have been troublesome in many waterfront areas. In most instances this has been due to the waterfront conditions at wharves, piers, and warehouses where abundant food supplies and rat harborages are available. The rats have access to ships by gangways, ropes, and by concealment in cargo. After several rats have boarded a ship, they nest and breed, producing large colonies. The conditions of the vessel are important in determining the extent of rodent population, and for this reason more emphasis is being placed upon ratproof construction and ship sanitation.

The greatest danger from rodents lies in their ability to spread disease. An infected rat may transmit certain diseases to seamen, as described below. Although the spread of disease by rats may occur ashore, the problem on ship is still more dangerous because of the many different ports contacted. If a ship harbors a rat population and enters a plague port, the disease may spread rapidly throughout the rat population and to the crew of the vessel. This same ship may then carry the disease into subsequent ports of call. This type of trouble may be expected when a ship harbors rodents, and when these rodents have free gangway at various ports. Rats can also do considerable damage to the ship by gnawing into timbers and insulation, by creating insanitary and unsightly conditions, by damage to cargo (especially food cargo), and by destruction of food stores in lockers and provision storerooms.

Rodents can act as reservoirs of disease aboard ship; they may be infected with pathogenic bacteria which live and grow in their bodies. Rats may develop certain diseases in chronic form and in this manner harbor and incubate pathogenic bacteria. They can also suffer a disease, recover, and then become "carriers" similar to human carriers in this respect. Thus, this animal is a reservoir of the micro-organisms which may be transferred to humans.

A rat may transmit certain diseases to man directly by means of bites, as in the case of "rat-bite fever." However, most rat-borne diseases are spread indirectly through rat excreta (droppings) or by means of the rat-flea. On a merchant ship which is rat-infested, rat droppings can be seen in great abundance in many parts of the vessel, and there is a good chance that such droppings will contaminate food in storerooms and galleys. A number of intestinal diseases have been spread in this manner.

Diseases can be spread from shore to ship, from ship to shore, from ship to ship, and throughout a port by means of the rat. This rodent is a more or less migratory animal that moves about in search of better nesting and feeding conditions and in this manner spreads disease into new areas. Infected rodents, in the ill or carrier stage, contact other rats, thus enabling transfer of disease from one rat to another. Then, too, the fleas from an infected rat may move to another rat, transferring the disease. It is common for fleas to leave sick or dead rats and seek new healthy hosts.

The first step in learning to control rat infestation is an understanding of their characteristics and activities. These rodents can adjust to many different conditions, including a wide range of food, shelter, and temperature. On ships, rats prefer to live in dark, quiet, and secluded areas where they will not be disturbed; if food is not available, they will forage at night or when the compartments are dark. They are nocturnal creatures, i.e. prefer darkness, and therefore are not observed in lighted compartments. The association of rats with man dates back to prehistoric times, and rats have become partly domesticated. Food, shelter, and other living conditions furnished accidently by man are more desirable than the natural facilities that might be available. In this association with man, the rat has utilized man's transportation systems to migrate to almost all parts of the world. Rats also migrate on a local scale, establishing regular marauding areas, and may radiate outward from established centers under the pressure of hunger or lack of facilities. They prefer to live in groups or colonies near a good food and water supply. The population of a colony will increase up to the limit of food and harborage accommodations. When overcrowding occurs,

new colonies are established. The food of choice for rodents is grain, or grain products, but they will eat all sorts of meats or vegetables. They will usually adjust their diet to the available surrounding supplies, and will frequently carry off and hoard foods. Although they require water, they can obtain much or all of it from juicy vegetables or fruits. Unfortunately, rats are prolific breeders. Litters of young, numbering from five to twenty, may be produced as often as five times a year by one female rat. The young remain in the nests for three to four weeks before beginning active marauding and new nesting.

There are three major species of rats that are of importance to shipping. A brief description of each is set forth here, to enable crude identification should this be necessary. *Rattus rattus,* also known as the Ship Rat, Black Rat, or Indian Rat, is prevalent on ships. This small rat, weighing 6 to 8 ounces, possesses a slender body, pointed nose, large ears, and a long tail. Its fur is black except for the belly area which is slate colored. This species is well adapted for climbing. *Rattus norvegicus* (Wharf Rat, Gray Rat, Sewer Rat, Brown Rat, or Norway Rat) is a large rodent, weighing from 10 to 16 ounces. It is a grayish brown, with a blunt nose and pyramidal tail. The preferred habitat is near the ground, and it nests in dumps, basements, and sewers. Because of these tendencies, it may live in the area of wharves and may get aboard ships. *Rattus alexandrinus* is also known as the Roof Rat or Palm Rat. It interbreeds with Rattus rattus, and resembles the latter except for its color which is grayish brown on the legs, head and trunk but white on the belly area.

The places where rats hide and live are called harborages. When such a place is actually occupied by rats, it is called an *active harborage.* If an area is well suited for nesting but is not inhabited, it is called an *inactive harborage.* Materials or areas which could be used by rats with considerable work and adjustment on their part are called *potential harborages.* Some of the most common rat harborages on merchant ships include areas built within the structure of the ship, as: spaces between double bulkheads; space beneath the tank-top ceiling; space between the overhead and deck; spaces behind sheathing; and spaces within pipe casings. Also, cargo in the holds, gear in lockers, and food stores in provision storerooms or other areas may act as harborages. Excess gear and dunnage, improperly stowed, furnish safe housing for rats. All of these areas may be either active or inactive harborages, depending upon whether or not rats are present. Potential harborages may become active harborages if rats put in the necessary labor to convert these materials into nests or shelters.

Although rats prefer to live close to food supplies, they may nest in areas where absolutely no food is available, for example certain of the cargo holds. In such cases, the rats will form regular "runs" or trails which they follow in foraging for food. Such runs may extend from the holds into the galley or provision storerooms, and the passageways used may include openings in bulkheads, decks, and overheads, or may be in pipe casings, or holes where pipes pass through bulkheads. Ladders and exposed gangways may also be used, especially during dark and quiet hours.

Rat trails or runs may be identified as greasy and dirty marks where the bodies of the rodents rub against surfaces. Such trails result from the constant passage, to and fro, of a number of rats. The rat trails are usually found in narrow passageways, or near small openings where rats coming from various directions must converge to gain access through a limited space. In holds and gangways, although a wide space is available, the rats usually prefer to slink along the bulkheads and thus may leave trails. Ledges, pipes, cables, or wires located against or near a bulkhead are favored objects for rat runs. A few trips made by a single rat through some area will not ordinarily result in a distinct trail. The trail of a single rat, or the individual trails of numerous rats may sometimes be observed in thick dust, in sand, or in exposed cargo of salt, flour or other fine-particled material. In spacious areas where rats are plentiful and are not disturbed, many other indications may be found in addition to the greasy trails. Rat droppings may litter the deck and dunnage; rat gnawings and other destruction may be in evidence.

All ships are subject to occasional infestation by rats, and in general 25% of all commercial vessels have some rats present. If a ship is of ratproof construction, sanitary, and if trapping is performed regularly, the number of rats may be kept down below a dangerous level. Permanent colonization by large numbers of rats is likely on vessels with extensive rat harborages.

It is interesting to note that many of the conditions which act as rat harborages are also fire hazards. Excessive dunnage and gear, or accumulated waste in recesses, corners, lockers, and ledges are potential harborages, and are obviously dangerous as possible starting points for fire.

The control of rats on merchant ships will pay dividends in the form of health protection, maintenance of more pleasant living conditions, and prevention of damage to food stores, cargo, and ship structure. A ship on which rats are under control will be saved considerable quarantine delay and may avoid the trouble and expense of repeated fumi-

gations. The measures used to combat rats may be divided into two general categories, preventive and destructive.

Preventive efforts are by far the most satisfactory. The killing of rats is only a temporary measure which will have to be used constantly as long as the ship is afloat. However, preventive measures such as ratproofing and cleanliness remove the underlying causes of rat-infestation of ships.

The statistics available from quarantine stations indicate that ratproof ship construction is effective to an amazing degree. Hundreds of ships require fumigation every year, but ships which are of ratproof construction are very rarely detained for fumigation. The United States Government has recognized this fact, and has established ratproofing standards which must be enforced in the building of new vessels. Every new ship must obtain a permit from the United States Public Health Service indicating suitable ratproofing. The major features of proper construction include the elimination of all harborages, plus construction which limits the movement of rats to prevent their operations between compartments. These measures prevent nesting or breeding, and prevent rats from moving freely throughout the ship. All "dead" or inaccessible spaces in the ship's structure are either eliminated or made secure against invasion by rodents. Thus, rats can be *"built out."*

The actual structure of the ship is only the first stage of ratproofing. The second step consists of proper maintenance. Cargo and gear should be properly stowed to avoid potential harborages. All access to food should be eliminated. Food stores should be kept in ratproof compartments or metal containers, and should be elevated at least one foot above the deck and two feet from the bulkheads. Garbage should be collected in leakproof cans with tight-fitting metal covers, and prompt clean disposal should be enforced. Starvation may kill rats, or at least reduce their rate of reproduction. Hungry rats can be trapped more readily, and may also reduce their own numbers by cannibalism. By these methods, rats can be *"starved out."*

"Rat guards" are metal discs fitted over the ship's lines to prevent rats from climbing on or off the ship by means of the lines. However, rats usually gain access to a ship by the gangway or in cargo, and do not attempt to use the lines to any great extent. Rat guards are sometimes improperly used, through failure to secure them properly, or through failure to place them on all lines.

The destruction of rats by trapping and killing is not very effective for permanent control. However, it may be a valuable adjunct to aid in keeping down the number of rats. If a ship is ratproof, and if the

few rats which get aboard are killed, no problem of rat-infestation should arise. If a ship is not ratproof, and if she is infested with rats, the killing of some rodents will only help to keep down the total number of rats.

There are several methods that can be used to kill rats. In the past, an acceptable standard measure was to carry a few cats. This is no longer advocated, since the amount of rat destruction accomplished in this manner may be negligible. Also, the cat may act as a vehicle of disease transmission, since it has "free gangway" and usually lives around the galley and crew's quarters.

Poisoned baits (treated with arsenic, strychnine, thallium sulphate, or other chemicals) have been used, but are undesirable for obvious reasons. The number of rats killed is usually not commensurate with the dangers entailed, since such poisons may find their way accidentally into human foods. Among the poisons used, red squill is least dangerous because it causes the human to vomit and thus is not likely to result in accidental poisoning of the men.

Trapping, if used persistently, can be effective to prevent the number of rats from reaching startling figures. Cage traps are not very effective and are recommended only when live specimens are needed for investigation. Ordinarily, the snap trap has been found to be much more effective. Such traps should be set along ledges and bulkheads, especially where rat runs are detected. The trap should be placed at a right angle to the run or bulkhead, with the baited trigger pointed in the direction from which the rat is expected. Baits which are suggested include cheese, ground meats, pieces of apple, oats, and corn meal. A person should determine what foods the rats are stealing, and then should bait the trap with another type of food which provides more incentive for the rat. Traps, should be set each day with varied baits and captured rats should be removed. Failure to do this is one of the most common causes of inadequate rat-trapping on merchant ships. Too often someone will set a few traps, forget about them for several days, and then state that there is "no use in trying to trap rats."

When a heavily rat-infested ship pulls into a port, the sanitary inspector from the quarantine station will recommend fumigation and will detain the ship for that purpose. The decision as to whether or not a fumigation is necessary is based largely upon the inspector's estimate of the number of rats present. If the evidence indicates that over 5 rats are present, the ship will probably be held for fumigation. Other factors are also considered; the ship's sanitary record, present sanitary condition, illnesses among crew, and recent ports of call enter into the final

decision. If a ship has recently touched at a plague port, and the inspection indicates the presence of any rats, that vessel will probably be fumigated. No one hard-and-fast rule can be laid down, since a number of variable factors will enter into the decision concerning each ship. However, the degree of rat-infestation is the most significant single factor.

Fumigation may be defined as the process of destroying vermin by the application of a gas, vapor, or smoke. Usually, the fumigation of a ship is performed to rid the vessel of rats. The second most frequent use of fumigants is to destroy insects, especially cockroaches. Fumigation is no longer used to any appreciable extent for destruction of bacteria, although such procedure was once common. The fumigant most frequently employed to kill rats and insects is hydrocyanic acid gas. Pancake-shaped discs of pulp impregnated with gas are used to distribute the chemical throughout the ship. These disc, called discoids, are scattered carefully throughout the ship in the proper number to yield the required amount of the gas. *The fumigant is extremely lethal to the human*, and great care is necessary in handling such a fumigation job. Only qualified and certified workers should handle fumigation.

A great portion of the total amount of work involved in fumigation is taken up in preparing the ship. There is considerable manual labor required, and this must be done by the crew or other hands provided by the shipping company. It is one of the factors which should make the shipping company and the skipper of the vessel grateful if the Purser-Hospital Corpsman can help to keep the ship in such condition that fumigation will not be required. The actual preparation of the vessel for fumigation is usually directed by the first mate or other designated officer; however, since it does involve the health and safety of all hands, the Purser-Hospital Corpsman should understand the procedure. Instructions will be issued by the quarantine station, and will resemble the following outline:

a. Vessels are to be ready for fumigation at or before 9:00 A.M. A vessel not fully prepared for the actual introduction of the fumigant before 10:00 A.M. will be fumigated at a later date.

b. Attention is called to the fact that ships required to fumigate by the Public Health Service are not permitted to bunker or load cargo prior to fumigation.

c. All passengers and members of the crew shall be evacuated before 8:30 A.M. except approximately 8 men, including the boatswain, carpenter, and a member of the steward's and engine department, who shall be standing by to complete unfinished details of preparation. As soon as this work is completed these men shall leave the vessel.

d. All members of the crew shall be accounted for and, with the exception of two men and the Chief Officer or other Watch Officer, shall leave the vessel before the

fumigation is started. A written certificate to this effect will be required of the Watch Officer.

e. A vessel is ready for fumigation only when the following requirements and preparations have been met and completed:

1. Holds shall be cleaned; trash, excess gear and dunnage piled in an orderly manner on elevated racks away from bulkheads.

2. Pipe casings and boxing around pipes, etc., shall be opened up or removed.

3. When rat infestation is evident, openings shall be made into spaces over tanks, between sheathings and bulkheads, ceilings and floors in crew's quarters, storerooms and in officers' and passengers' accommodations.

4. The outside rows of hatch covers are left on. Each alternate hatch cover is removed and placed on deck. Two good tarpaulins should be spread to cover each hatch opening, leaving the two opposite corners open. All tween-deck hatch covers are removed. Adequate supply of wedges should be available.

5. All ventilators and similar openings shall be closed and made gas-tight.

6. The forepeak, aft peak and all other storage compartments shall be cleared of excess canvas, dunnage, gear and other material which will interfere with adequate penetration of gas or the recovery of rodents after fumigation. This may be accomplished either by removal to an open deck or removal from the vessel.

7. Doors to all compartments and rooms, including quarters, shall be opened and left on the hook. Drawers shall be pulled open. All personal lockers of every description shall be opened. Mattresses are to be raised to a peak in the center. All store rooms, ice boxes, refrigerators, etc., shall be unlocked and made accessible for inspection and fumigation.

8. All ports shall be closed tightly and secured with one screw. Leaky ports shall be stuffed or otherwise made gas-tight.

9. Galley fire shall be out. Dampers and vents to be closed.

10. All pets and animals of every description have been evacuated and any such animals or pets left on the vessel shall be kept on an open deck at the owners or operators responsibility and risk.

11. To protect against possible corrosive effect of the fumigant on unfinished floors, the vessel shall provide a sufficient amount of heavy paper or other similar material to be used for protection at such locations as may be indicated by a representative of this office.

12. When compartments are under customs seal, arrangements should be made with the proper customs official to open such compartments immediately prior, to fumigation for the purpose of inspection and fumigation.

13. The vessel shall have been made safe to leave for six to eight hours while undergoing fumigation.

14. Vessel shall not be berthed within 25 feet of any vessel, tug or barge during fumigation.

15. Cargo booms shall be rigged over each hatch in such a manner as to permit the erection of windsails for ventilation following exposure to the fumigant.

The preparations for fumigation, as described above, are of great importance in determining the safety and effectiveness of the fumigation job. Since the gas is a deadly poison, all persons must be logged off the ship with the greatest of care, to be sure that no men are asleep in bunks, working in the holds, etc. The entire area to be fumigated must be airtight so that the proper concentration of gas can be obtained, and all

materials must be exposed for adequate penetration of the gas. The galley, storerooms, and even the refrigerators may be exposed to hydrocyanic acid gas without damage. As a matter of fact, these areas may be in greatest need of fumigation.

After all the procedures listed above have been completed, and not until then, the ship is ready for fumigation. By this time, the fumigation squads will be ready to take over. They will have their equipment in readiness, will have their plan mapped out, and will be ready to begin their operations. The chief of the fumigating crew will have calculated beforehand the amount of gas needed. It is interesting to know how he does this, because he requires certain information regarding the ship. Chiefly, he must know the cubic capacity of the entire area to be fumigated, and of the various individual holds and compartments. From this data, he is able to compute the amounts of gas needed. The usual dose of hydrocyanic acid gas is 2 ounces per 1,000 cubic feet of space. Under ordinary conditions, this will destroy all rats unless they are safely hidden in deep inaccessible recesses; this is why proper preparation of the area is essential. However, a dose of 2 ounces per 1,000 cu. ft. will not destroy cockroaches or other insects. Destruction of insects requires at least 4 ounces of gas per 1,000 cubic feet of space.

INSECTS

The presence of insects aboard ship not only creates unpleasant conditions, but may foster the transmission of certain diseases. Furthermore, large numbers of insects indicate lack of adequate sanitary control. Seamen notice cockroaches more than any other insect, because roaches are frequently present in large numbers in the galley and mess halls. However, several other insects are more dangerous than roaches but less conspicuous. They include lice, fleas, mosquitoes, and flies. These may be far more dangerous than the roach because they can transmit serious diseases. The body louse, for example, may transmit typhus fever; the rat flea may spread bubonic plague; certain types of mosquitoes spread malaria and others spread yellow fever; flies may spread a number of intestinal diseases. Thus, the Hospital Corpsman should be interested in the detection and the control of various forms of insect life that may be present on a ship. For his information, a discussion of each of the more important insects is presented.

Cockroaches and ants usually get aboard in food supplies or certain types of cargo. Body insects such as lice or bed bugs are most commonly brought aboard on the bodies of men, on their clothing, or in their personal gear. The rat flea comes aborad on rats; this problem may be

minimized by following the precautions for rat-control previously described. A number of flying insects such as the mosquito or fly will come aboard from shore by direct flight, but it should be noted that flies may be attracted by odors produced from poorly handled garbage or improperly stored food.

Each type of insect will choose the area on the ship where it can find the most suitable harborage and food supply for its particular needs. Roaches will usually be found in the area around the galley, provision storeroom, or in holds containing food. The simplest method to detect roaches is by turning on the light in a dark room; the roaches will be found in large numbers in warm areas, for example, near steam pipes. They are found in greatest numbers in sheltered areas such as on bulkheads behind stoves or cupboards. Bedbugs are found almost exclusively in sleeping quarters by looking in the bedding, especially in mattresses; also in the cracks of frames or boards, or in similar structural seams. Their detection is not always easy, and may require close inspection with good lighting. Lice may be found on the person's body more commonly than elsewhere; they may be divided into three types, namely, body lice, head lice, and pubic lice. To some extent these insects may also be found in bedding and in clothing, especially in the seams of garments. Flies and mosquitoes may be observed about the ship when she is tied up either in the harbor or at piers. The number found will vary greatly in different ports; it should be remembered that, in a port where flies abound, good food sanitation and proper waste disposal will prevent much annoyance from this source. Mosquitoes will probably not be a serious problem in most ports, although in tropical areas they often present a real danger. The prevalence of mosquitoes in the port and the direction of prevailing winds will largely determine the extent of this particular problem.

A few insects of various types are bound to find their way onto every merchant ship. This is only to be expected since there are so many opportunities for insects to be brought aboard in food, stores, cargoes, on bodies or clothing of seamen, or by means of flight. However, if proper conditions are maintained on the ship, these insects should not become abundant. Whenever intolerable conditions of insect infestation develop, it is likely due to carelessness or indifference on the part of the ship's officers or crew members. This is best exemplified by heavy infestation of roaches in the galley areas; it is true that a few roaches sooner or later come aboard in the provisions, but if the galley and storeroom areas are clean no serious problem should exist. Similar carelessness is the main factor whenever the ship becomes heavily

populated with lice, fleas, or bedbugs. One of the best constant measures for control of all these insects is simple cleanliness, with frequent and abundant use of plain soap and water. In the case of flies or mosquitoes, the fault usually lies in failure to provide adequate screening or in failing to use the ventilation system rather than open doorways and portholes. This problem is accentuated in tropical areas where disease-carrying flies and mosquitoes may be prevalent.

It is realized that some factors involved in insect control lie beyond the direct duties of the Hospital Corpsman. However, the Hospital Corpsman is interested in preventing the spread of all diseases aboard his ship, and for this reason he should take an active interest in control measures. It is further realized that he cannot accomplish this at once, but it is hoped that he may be able to institute gradual changes in the proper direction. Many of the insect problems aboard ship are simply the result of indifference, which in turn results from a lack of appreciation of the dangers of such conditions. In this chapter, the dangers and the remedies are described so that the Hospital Corpsman will himself be informed and so that he may diplomatically spread a few words and ideas to the responsible officers and crew members.

The extent of insect infestation is frequently noted by Quarantine Officers, Sanitary Officers, or other Health Officers boarding a vessel, and used as an index of the general sanitary condition of the ship. Thus, the ship on which many insects are found is much more likely to be delayed for close scrutiny.

There are four species of domestic cockroaches, whose differences are chiefly in size while their habits are similar. Eggs laid in cracks and crevices. They develop into larvae and then into adults. This period of development may require 6 to 12 months. Roaches will eat almost any sort of human food, but also gnaw on other objects. They are night prowlers, and will usually hide in daylight or when compartments are lighted. It is not certain that roaches transmit disease, although they are suspected. However, they do constitute a nuisance, destroy property, and are indicative of poor sanitation.

The best methods of control lie in the protection of food supplies and food cargoes, supervision and cleanliness in the galley and mess rooms, cleanliness of "heads," not allowing food in sleeping quarters or gear lockers, and not allowing food scraps to accumulate anywhere. Another general factor is the elimination of various crevices which may serve as breeding places or as hiding places for these insects. Accumulations of grease and food scraps in the galley, especially in corners and *under-surfaces* of tables, sinks, or other fixtures are sources of food for roaches.

Inspection parties should seek to remedy such conditions. Grease on fixtures, bulkheads, and decks should be removed promptly by use of soaps or detergents plus vigorous labor. (Grease around the stoves also constitutes a fire hazard, and on decks may result in accidents from slipping). Food which is not in use for preparation of a meal should be kept in closed jars, cans, or other vermin-proof containers. These measures are necessary for permanent control, and must be supervised constantly.

Although the above permanent measures are recommended, occasion will arise when it may become necessary to kill roaches. This can be done by the use of poisons, roach traps, or by fumigation. Killing a large number of roaches from time to time results only in a temporary reduction of their numbers; if the conditions are not remedied the insects soon multiply and the same type of condition will recur. A number of "roach powders" are available; most of them are dangerous to the human. The destruction of roaches by poison is dangerous because such measures are most frequently used in the galley where the powder may be introduced accidentally into the food. It is important, that poison be kept properly labelled to help offset this danger. As a further aid, these powders, such as sodium fluoride, are usually colored distinctively in a blue or green tinge to prevent their being mistaken for food ingredients. Roach powders which are not distinctively colored should not be used. When powdered insecticides are used, they should be scattered or blown into crevices and corners where the roaches are found. Use of roach powder is not a substitute for cleanliness.

Once a ship has become heavily infested with roaches, fumigation is a highly effective means of destroying all insects. This process is almost identical to the fumigation methods used to destroy rats. The major difference lies in the fact that a higher dosage of gas is necessary; while a dose of 2 ounces of hydrocyanic acid gas per 1,000 cubic feet is sufficient for rodent destruction, a dose of 4 ounces per 1,000 cubic feet is needed to kill insects. It should be noted that whenever a higher dosage is used, the problem of thorough ventilation after fumigation becomes still more important to prevent human illness or death from remaining gas. Remember that all fumigation jobs must be done by skilled operators. Following fumigation, a relatively small proportion of the roaches may still be alive, having escaped death by hiding in inaccessible areas where the gas did not penetrate. Also, more roaches will develop subsequently from eggs which were not destroyed by fumigation. For these reasons, cleanliness plus insect destruction must be continued to prevent a serious re-infestation. D.D.T. if properly applied offers promise of becoming a very effective means of roach control and may supplant fumigation for this purpose.

Bedbugs are blood-sucking insects. It is possible that they transmit blood-stream infections, although this has not been demonstrated conclusively. It is certain, however, that these insects are the source of much annoyance and loss of sleep. Furthermore, the irritation produced by bites causes the person to scratch vigorously and risk skin infection. The insects are spread by their presence on the human body, on bedding, on clothing and in furniture. Eggs, which are produced in groups of 150 at one time, hatch in seven to ten days, and grow into adults in about ten weeks. The adult bedbugs usually feed every three days, but may live for months without feeding. The adult insects usually hide from daylight or strong artificial light, so that close examination within bedding, under mattresses, and through clothing is required to locate them.

Cleanliness is the best over-all method of preventing serious bedbug infestation. However, these insects may be introduced into clean quarters, and will remain until destructive measures are used. The latter measures include fumigation, use of dry heat or live steam, and insecticides.

Lice are parasitic insects which may infest man's body, head, or pubic region. When a person is infested by lice, the condition is called *pediculosis*. These insects feed by puncturing the skin of the host, injecting saliva, and removing blood. They usually feed every three or four hours, but can live about three days without food. The normal life span is thirty-four to forty days. A female lays 8 eggs daily, and these require eight days to hatch and produce the nymph stage. Growth is best at 87 degrees Fahrenheit; lice do not multiply in temperatures below 72 degrees Fahrenheit or above 104 degrees Fahrenheit. Lice live and mutiply on the human body or clothing, and are distributed by close contact of men and by bedding or clothing. They transmit disease through bites, through irritation of skin, and contamination of scratches or wounds.

The control of lice is based upon the use of various forms of heat or chemical insecticides. Dry heat of 155 degrees Fahrenheit applied for one minute, or 130 degrees Fahrenheit for five minutes will destroy lice and their eggs on articles which can stand this temperature without damage. For some articles, immersion in boiling water for at least one minute will be effective. Flowing steam is used frequently for delousing; clothing, bedding, or similar articles may be hung in a chamber or container through which steam is passed for thirty miuutes.

Until recently, a number of chemicals such as cresol, naphthaline, vinegar, kerosene, and gasoline have been used for delousing operations. For example, a 5% solution of cresol was used for thirty minutes to

kill lice and their eggs or immature form on articles such as leather which could not be boiled or steamed. However, during World War II a new and very effective insecticide powder has become available. This is known as *DDT* and has replaced practically all other delousing chemicals. DDT can be dusted on the body and rubbed into clothing. It received its first large-scale tryout when the Allies occupied the Mediterranean countries. Louse-borne typhus fever was present in dangerous proportions; Allied troops and civil propulations alike were faced with the prospect of a serious typhus epidemic. DDT proved of great value, not only because of its strong and lasting insecticidal powers, but also because of the ease with which it could be used. In powder form, it could be blown directly onto clothing, through sleeves and collars, thus delousing the body and the clothing at once without requiring the usual dressing stations and showers that were needed in the earlier delousing methods.

Whenever delousing is performed, it must be thorough to prevent immediate re-infestation. If a person's body is completely freed from lice, his bedding, clothing or other louse-infested articles must be deloused at the same time. Delousing procedures, including the use of insecticide powders, are not a substitute for personal cleanliness. Frequent thorough baths or showers, with an abundance of good soap are effective in retarding louse infestation.

Fleas are specialized as regards the host they select, for example, the rat flea prefers to live on rats. However, the insect may change hosts on occasion; a flea may leave a rat and bite a human. In this manner, the flea may transmit diseases from rats or other animals to the human. The insect feeds by puncturing the skin of its host and sucking up blood. At this point, disease-producing organisms may be introduced; or shortly thereafter, when the victim scratches the "bite," he may introduce infection into the area. Normally, the flea feeds frequently, but it can live as long as thirty days without feeding. The control of fleas is best accomplished through the elimination of rodents which might act as hosts for the flea. Pet animals can also serve as hosts and must be kept free of fleas.

Back in the days of sailing vessels, mosquitoes were a constant annoyance and danger because a large quantity of water was stored in tanks under insanitary conditions. Present day vessels have more carefully guarded water supplies and more rigidly controlled sanitary conditions. Nevertheless, mosquitoes present a real danger in tropical ports, where mosquitoes are not only very prevalent, but where they are infected with or carry diseases which can be transmitted to man. The dangers

may be grouped into three major divisions; (1) men going ashore on liberty or leave will be exposed to these mosquitoes; (2) the vessel may be near shore, with an off-shore breeze which carries the mosquito onto the ship; (3) after a vessel pulls out of a tropical port, mosquitoes may continue to breed in various receptacles containing water.

The control of mosquitoes is largely a shore problem beyond the jurisdiction of the Hospital Corpsman. However, he should be aware of such conditions and anticipate the dangers. He should realize that his men who go ashore in certain tropical ports may be exposed to mosquito-borne malaria, yellow fever, dengue fever (breakbone fever), and possibly filariasis; the particular danger is determined by the types of disease and types of mosquito prevalent in that particular port. The control of the shore problem is difficult; in certain areas where it is extremely serious, the Hospital Corpsman may advise against shore leave, or may warn the men regarding the conditions in that port. In malarial areas, he will use suppressive doses of quinacrine administered to those men who do go ashore. After having left such a port, he may be on the lookout for the appearance of these mosquito-borne diseases among the crew members, and be ready to institute remedial measures should they become necessary.

The control of mosquitoes aboard ship falls more directly within the jurisdiction of the Hospital Corpsman. Should his vessel be tied up in a malarial region, he should make every effort to keep the compartments free from mosquitoes by proper screening. The screens should have 18 meshes to the inch. He may also want to use insecticides to destroy mosquitoes should they be present in large numbers. There are many effective insecticides now available, including DDT and pyrethrum.

Under emergency conditions in malaria-ports, use of netting around the bunks may be desired. Nets must fit completely around the bunk without gaps and with all edges securely tucked in; the nets should be inspected to be certain they are intact; the men should be instructed to keep all parts of body away from the net (if an arm is allowed to rest against the net the mosquito may bite the victim through this net).

If mosquitoes remain prevalent aboard ship after departure from port, the Hospital Corpsman should investigate the possibility of breeding areas, such as discarded or unused water-filled containers, jars in galley, fire buckets, etc. Water should be emptied from all unused receptacles; necessary water containers may be "oiled" by placing a few drops of oil on the water to form a very thin film. Fire buckets may be screened with an easily removable cover of 18 mesh wire.

The mosquito is an insect which undergoes a rather complicated life

cycle. Eggs are laid by the adult mosquito on the surface of water and will hatch into larvae ("wrigglers") in from one to three days. After seven to ten days the wrigglers develop into a pupa stage still in the water. In this pupa stage, the insect lives just under the surface of the water and breathes by getting air from the surface. Thus, if a substance such as oil is placed on the surface of water, the insects will die because they cannot get air. After a few days in the pupa stage, the adult form of the mosquito emerges at the surface and is ready for flight.

The feeding habit of the adult mosquito consists of puncturing the skin of the host, injecting saliva into the puncture, and then withdrawing blood. The transmission of disease is usually accomplished at the moment the saliva of the mosquito is deposited, because the saliva may contain disease-producing organisms. This is best exemplified by malaria, for the malarial parasites are introduced in this manner.

There are several different types of mosquitoes; only certain types transmit diseases, as outlined below:

Anopheles mosquito	Malaria
Aedes mosquito	Dengue; and Yellow Fever
Aedes or Culex mosquito	Filariasis

Flies usually breed in garbage, excreta, or other filth. Eggs are laid, 100 at a time, and develop into maggots within twenty-four hours. They exist as maggots for four or five days then as pupae for several days after which time they emerge as adult flies. Because of their association with filth, flies may transmit a number of diseases, chiefly the intestinal group. Most frequently, the organisms will simply be carried on the surface of the fly's body and become deposited on food or other articles; these organisms subsequently find their way into the human intestine, usually on food. Certain flies, such as the tsetse fly, may introduce micro-organisms directly into the skin by means of bites.

The control of flies may be best accomplished by the elimination of breeding places through the proper disposal of waste and garbage, and by keeping all foods properly protected. They may also be eliminated to a large extent by proper screening and ventilation. Should they be aboard, they may be killed by the use of fly poisons, insecticide sprays, or by mechanical means such as fly paper, or by the usual method of swatting.

Ants are not a public health menace, although there is a slight possibility that they may carry harmful bacteria on their bodies. Nevertheless, these insects are a nuisance and may damage food supplies. Prevention of ant-problems lies in an adequate protection of all food. Destruction of ants may be accomplished by pouring boiling water over ant nests or large groups of ants. Sodium fluoride or other insect

poisons may be placed in crevices frequented by ants, but with care to avoid introduction of poisons into food supplies.

EPIDEMIOLOGY

In the course of his voyages, the Hospital Corpsman will encounter serious epidemics in various ports of call and may be faced with diseases of epidemic proportions on his own vessel. To enable him to cope with such situations in a reasonable and effective manner, the fundamentals of epidemiology are presented here.

An epidemic may be defined as an abrupt rise or a flare-up in the number of cases of a particular disease, resulting in unusually high incidence in the area or population group involved. The term epidemic is used in reference to specific diseases, as: "epidemic of bacillary dysentery" or "cholera epidemic". Epidemiology consists of the study of epidemics, primarily for the purpose of control.

In many parts of the world, certain diseases are present constantly. In such a case, if there is no sudden flare-up, and a level of incidence is maintained year after year, such a condition is called *endemic*. It should be noted that the terms epidemic and endemic are relative to the area and population group concerned. For example, dysentery is endemic in many parts of the Orient. However, should the same percentage of cases (number of cases in proportion to the population) occur in New York City, the condition would be called an epidemic because such a number of cases would represent a sudden flare-up of the disease in New York.

The work of the Hospital Corpsman in relation to epidemics can be divided into two main types; first, he should be able to protect his shipmates against epidemics in ports of call, and secondly, he should be able to control an outbreak of disease aboard his vessel.

When his vessel enters a port, the Hospital Corpsman should learn whether or not epidemic conditions are present. If they are, he should institute preventive measures. In extreme instances, he may recommend to the master that the men be given no shore leave or shore liberty. In other instances, he may screen out crew members who have not been successfully immunized against certain diseases; for example, if a cholera epidemic exists in the port and several crew members have not received complete immunization against cholera these individuals might not be allowed ashore. The Hospital Corpsman should also advise crew members as to the epidemic condition existing in the port, and suggest preventive measures. For example, if there is a severe outbreak of dysentery in the port, the seamen should be informed that dysentery

is spread primarily through food and water; that if any food or water is consumed by the individual, the water should be boiled (as in coffee or tea), the food should be most thoroughly cooked, and no raw foods such as fresh vegetables should be consumed. The effectiveness with which these suggestions will be carried out by the men will depend very largely upon the manner in which the Hospital Corpsman presents the information. It would perhaps be most effective for the Hospital Corpsman to point out this problem to each individual going ashore as he receives pay or makes out the necessary papers, and to emphasize the fact that this information is for the protection of the man's own health as well as the health of all other men in the crew. It is probably wise to indicate that any one man who goes ashore and carelessly exposes himself to diseases may, upon returning to the vessel, endanger the health and lives of his shipmates. Venereal diseases are prevalent in many ports and the seaman may be favorably influenced by a realization that venereal diseases cannot always be cured by remarkable and rapid measures; that such diseases frequently interfere with a man's career and may spread to his family upon his return home.

It is noted in the above discussion of disease conditions in port, that the Hospital Corpsman is concerned only with preventing the introduction of diseases into the crew. However, once a disease does develop among the crew, the Hospital Corpsman has a double responsibility. He must not only care for the patient but must also take all possible precautions to prevent the spread of the disease to other crew members. Not only should the Hospital Corpsman render proper treatment to the patient, but he should also institute the necessary isolation measures. The nature of such measures will depend upon the type of communicable disease present. Isolation of a patient with an intestinal disease requires different procedures from isolation of a patient with a respiratory disease.

If several cases of a disease develop simultaneously after a ship leaves port, the Hospital Corpsman should attempt to determine whether the primary source of the infection was ashore or present on the vessel. In the latter case, if the disease is respiratory, it is most likely being spread by one of the crew members who has been noted as ill (although he may be a carrier without symptoms). If the diseases is intestinal, there is a possibility that it may have originated in the water or food supplies. If it originated in the water supply, one may expect numerous cases scattered throughout the entire crew. If it originated in the food, the cases will be limited to those men who ate a certain food. Investigation of all cases should be made to determine

which food was eaten by all of the sick individuals. Also, a distinction may be drawn between officer mess and crew mess, should the cases be confined to either the officer group or the crew.

The previous paragraph gives some idea of the type of detective work necessary in tracking down the source of an outbreak of disease. It is difficult to outline this subject thoroughly, since a good deal of individual ingenuity is necessary in each particular case. However, it is possible to lay down certain approaches which may serve as a guide. The Hospital Corpsman should first attempt to diagnose the disease. If he cannot do this, he should at least determine the general nature of the disease such as respiratory, intestinal, venereal. In the absence of a definite diagnosis, a knowledge of the general nature of the disease will facilitate control because it enables an understanding of the mode of transmission. The Hospital Corpsman can determine not only the probable source of the outbreak, but can also institute the general measures such as isolation, investigation of food or water, and inspection of crew members in an effort to find all cases of the disease. The Hospital Corpsman should attempt to understand how the infectious organisms may get from the body of the sick individual into a new and healthy victim; he should attempt to determine the possible vectors or agents of transmission; he should try to determine how the organisms may live in the environment after leaving the patient. He should attempt to discover any foci of infection and eliminate such sources. He should institute a "case finding" campaign among the crew in order to be certain of discovering, treating, and if necessary isolating the cases. All of this work should be done with the knowledge and cooperation of the master of the vessel. If the Hospital Corpsman is quite sure of the condition and its potential dangers to the crew, he should point out the condition carefully to the master in an effort to secure his support and cooperation in controlling the outbreak.

VITAL STATISTICS

In his travels, the Purser-Hospital Corpsman will gain familiarity with disease conditions throughout the world; he will learn to associate certain diseases with certain ports. He can learn this casually through experience, but can learn more rapidly and more accurately by means of statistics. Such data may be obtained from the boarding officer or from compilations of disease conditions prepared by governmental authorities. He may note these summaries of port health conditions and may use this information to anticipate and offset some disease dangers. Usually the figures indicate the number of cases in proportion to the

total population, since a crude figure such as "40 cases of bacillary dysentery" cannot be significant unless compared with total population and period of time. For this reason, certain standards are used.

A *rate* is usually computed to obtain a fair comparison of data by establishing certain base numbers. For example:

> The crude death rate (deaths from all causes) is based upon the total number of deaths *per year, per 1,000 population*. Thus, if the crude death rate for a particular port is "14", it indicates that 14 persons per 1,000 population died during that year from all causes.
>
> The specific death rate (deaths resulting from a specific cause) is based upon the number of deaths from that one cause *per year, per 100,000 population*. If the tuberculosis death rate for a city is listed as "92", it reveals that 92 deaths per 100,000 population resulted from tuberculosis for that year.
>
> The morbidity rate (illness rate) is based upon the total number of reported cases of the disease in question, *per year, per 100,000 population*.

A case-fatality rate is computed by noting the number of *deaths* from a specific disease *per 100 cases* of that disease.

Statistical information available to the Purser-Hospital Corpsman will enable him to anticipate disease conditions in a port of call, and to be prepared with preventive measures and treatment facilities for these diseases. A knowledge of the conditions in port may help him to ascertain the medical supplies and other equipment that may be needed. He will be able to submit authoritive information to the ship's master, other officers, and crew, regarding the disease dangers. After he leaves the port, he will also have a clue as to what diseases may be expected to occur aboard ship during the next several days.

Upon the completion of a voyage, the Hospital Corpsman will find it valuable to summarize the medical conditions of the voyage. This will not only enable him to replenish supplies, but will also serve as a guide in determining what additional medical materials and facilities may be desirable. Thus, the statistics of a voyage can be used by the Hospital Corpsman to substantiate his request for supplies and equipment as well as to aid him in improving the quality of his work.

HEALTH PROGRAMS FOR MERCHANT SEAMEN

One of the most urgent problems of the merchant marine is the need for improved cleanliness. Some seamen are prone to condemn a vessel as unclean and unfit to live on, although they themselves are largely responsible for its condition. Many of the insanitary conditions

which exist are created by negligence and indifference. Frequently, this negligence is due to a failure on the part of the individual to appreciate how his particular actions result in slovenly conditions. He may himself be guilty of dropping food scraps, papers and other debris on the deck; he may keep his own personal gear, his clothing and his bunk untidy, yet nevertheless he will condemn the ship because it is insanitary. Usually such an attitude results from a lack of appreciation as to the causes of unclean conditions. The Hospital Corpsman may notice one of the mess hands walk most unconcernedly over meat or other food products lying on the deck of provision storeroom or refrigerator. He may notice roaches in food served nonchalantly by an uninformed mess hand. Foul air, dirty clothing, dirty linen, and untidy lockers may frequently be noted in the crew's quarters. Unpleasant conditions in the head indicate carelessness on the part of individuals.

The Purser-Hospital Corpsman will find it desirable to operate on the happy assumption that most men will do the right thing if they know "why" and "how." It is a well-known tendency on the part of some seamen to resist new developments and new regulations unless the latter are fully explained and the reasons presented in such a manner as to receive the support of the men. Work in this direction can be best accomplished through gradual education of the individual crew members, since each man is interested in his personal health and welfare. The Hospital Corpsman can do this education constantly as a side-line whenever he contacts individual crew members. The men will come to him when they are ill or injured, when they want shore liberty or leave, or when they want personal advice on various problems. These will be ideal moments for subtle health education. The Hospital Corpsman has the opportunity for personal discussion and at this time can present comments and suggestions regarding the small details which contribute toward improved cleanliness. Men going on shore leave will appreciate a few well-meant words of advice regarding health protection ashore and will be most receptive to the ideas presented in personal conversation.

The Hospital Corpsman also has opportunity to point out unhealthy conditions to other ship's officers who may have overlooked some of these difficulties or who may have become so accustomed to these situations that they have taken them for granted. The Hospital Corpsman will find it valuable to accompany the ship's master on his tour of inspection. The Purser-Hospital Corpsman is likely to be included in such a tour because he is the person who will be asked to make

any reports that may be necessary and to keep the records of such inspection. While he is acting as a Purser in this capacity, he can also utilize his position as a Hospital Corpsman by aiding the master in the detection of various unwholesome or unhealthy conditions and by suggesting various possible remedies and improvements. He should be particularly careful that his advice is realistic and that his recommendations can actually be accomplished. Rather than to attempt to remedy everything at once, it will be more valuable to select one particular detail such as roaches, or decomposed food, and to center efforts on this one feature until it is corrected.

Every hand must appreciate the fact that wholesome living conditions will result only through the cooperation of all concerned. Unfortunately, the Hospital Corpsman has no "miracle chemicals" which will substitute for personal cleanliness, tidiness, and hard labor in keeping things clean. Many gallons of disinfectant will not overcome filthy conditions in heads; good honest labor is the essential equipment needed for such purposes, and the only way in which this labor can be minimized is by careful cooperation of all hands in maintaining cleanliness.

The best approach to remedy an insanitary condition lies in a *tactful* and considerate explanation of purpose. A newly-trained Corpsman may be perfectly correct and scientific in his criticism of an insanitary condition maintained by an "old-timer". However, this knowledge and criticism will be worthless unless it creates improvement; blunt criticisms will have no effect except to create resentment. The men should first be taught the values of improved sanitation; this will make them far more receptive to stricter enforcement of sanitary measures. The Hospital Corpsman should not be a "meddler," but instead should gain respect for his sincere interest in the health of the men.

The War Shipping Administration instituted a comprehensive health program which includes medical examination and immunization of merchant seamen. Every seaman should appreciate that these activities have only one purpose; namely, the protection of his health and his life. The Hospital Corpsman, with his own genuine appreciation of the values of "physicals" and "shots" should act as a missionary to aid in the effective operation of the program.

Some men look upon medical examinations as an annoyance and inconvenience involved in the "red-tape" necessary for signing-on. This view is completely incorrect. The examination may prevent a man from signing-on if his duties would seriously harm his health or endanger his life. If his condition is due to a remediable defect, he may

be offered hospitalization or other medical treatment until he is able to ship out with a clear physical record. In this manner, the individual seaman is protected against irreparable damage to his own health, damage which might have resulted if the condition had not been detected by the "physical." Furthermore, the work required of one seaman frequently involves the safety of others; physical impairment or physical inadequacy at certain tasks may result in serious injury to other men, and may interfere with the safe operation of the vessel. For the benefit of the man himself, and for the protection of the other men, any serious illness or remediable defect should be treated before the man ships out. Likewise, any serious communicable disease should be cured, or should be treated until there is no danger that the disease may be spread to other persons.

It may be noted that the terms "medical examination" and "physical examination" are used more or less interchangeably. However, the term "medical examination" is preferable, since the complete condition of the individual should be studied; social, mental, and emotional factors are considered in addition to actual physical condition. Social and emotional adjustment may be analyzed by the medical examiner by means of conversation during the physical phase of the examination, or through subsequent discussion.

Signing-on examinations are intended to discover cases of communicable disease, serious mental disorders, and conditions requiring surgical care. If the man fails to ship within a specified number of days after his signing-on examination, he may be asked to return for another "check-up" examination before signing articles. Annual medical examinations are more comprenhensive than the signing-on examinations, and may include chest x-ray, serology tests, blood count, and other clinical studies.

In January of 1944, a program for immunization of merchant seamen was instituted by the War Shipping Administration to be applied to "—all licensed and unlicensed personnel employed on all American, Honduran, and Panamanian flag vessels owned by or under bareboat charter to the War Shipping Administration". The object of this plan, now in operation, is the safeguarding of the health of all American seamen. An educational campaign is conducted to acquaint seamen with the values of immunization and to obtain their cooperation in carrying out the plan. Each man receives a card containing a record of his immunizations; this card is required for sign-on.

The basic immunizations are those against smallpox, typhoid fever, and typhus fever. In addition, yellow fever and cholera immunizations

may be required of men who enter areas where these diseases are prevalent. Immunization against tetanus is optional, since it is for personal protection, i.e., the disease will not be transmitted to other crew members.

This program for immunization of merchant seamen is beset by several problems. The series of injections requires four weeks for completion, and it is difficult to have the seaman available for regular appointments over this period of time. The man may not be in port long enough, or if he is on leave he may find it very difficult to come for treatment at a specified time and place. For these reasons, it is necessary for the Hospital Corpsmen aboard merchant ships to aid in the program by completing the immunizations at sea. A seaman may be able to receive the initial inoculations ashore and the remaining injections while at sea. The Hospital Corpsman should prepare himself for this duty. He must be responsible for the storage of biologicals, and for their proper administration. Immunization schedules must be carefully planned to prevent interference with the efficient operation of the ship.

A few seamen will not wish to receive the immunizations or to complete the series. Some of them may become more willing if the values are explained in terms of personal protection against disease. The opportunity to receive immunization should be considered as a privilege to which each seaman is entitled. Further enticement may be needed, however. Sometimes a suggestion from the ship's master may be helpful. Also, a most convincing case can be built up by pointing out that the Army and Navy prohibit unimmunized men ashore in many foreign ports by insisting upon complete immunization records for all men granted shore liberty.

CONTROL OF VENEREAL DISEASE

A venereal disease may be defined as an infectious disease which is ordinarily transmitted by sexual intercourse. *Syphilis* and *gonorrhea* are the most prevalent venereal diseases; every year hundreds of thousands of new cases are reported in the United States. Venereal diseases have been called the greatest of modern plagues because they have resulted in many deaths, as well as being the prime cause of misery, disability, and loss of effectiveness for millions of persons. In World War I, venereal disease ranked second only to influenza as a cause of absence from duty among United States forces, and probably would have been first on the list were it not for the influenza pandemic which

occurred at that time. The Army lost over 2,000,000 man-days of service from May 1917 to September 1918 as the result of venereal diseases. To properly evaluate the loss, it is necessary to add to this figure the amount of medical care required, the amount of individual suffering, and the impairment of individual efficiency. Note that this represents only one sample of the population, within a selected group of healthy young men largely free from such disease at the time of selection; the over-all picture for the entire population reveals startling losses. It is inexcusable that such conditions have existed, and even now exist, despite the fact that *venereal diseases are readily preventable.*

Syphilis was first recognized as a clinical entity at the close of the fifteenth century, and has run rampant until the twentieth century. Shortly after 1900 the causative organism, Treponema pallidum, a spirochete, was detected and identified. After that, considerable experimentation led to the development of treatment with "specifics," and the development of "blood tests" for diagnosis. Today, the disease is quite thoroughly understood by medical science, and techniques for prevention, detection and treatment are well perfected. The major reason for its continued wide-spread prevalence lies in the failure of individuals to learn and to use this knowledge.

Most transfer of syphilis results from direct contact of the new victim with the spirochetes on the body of the diseased person. This is most likely to occur as the result of sexual intercourse with syphilitic persons; kissing, or other direct body contact may also cause the transfer of spirochetes and subsequent infection of the victim. Transmission via intermediate objects such as towels, clothing, or eating utensils is possible but unlikely. In 95% of all cases (exclusive of infants) the entry of spirochetes occurs through the sex organs.

The first appearance of syphilis is often marked by the development of a small red area, usually painless, at the site of entry of the organisms. This small "sore" or chancre may be so inconspicuous as to escape detection. Nevertheless, the chancre is teeming with the spirochetes of syphilis. The chancre appears most frequently about 21 days after exposure, although the period (incubation period) before its appearance may be 10 days or less up to 90 days or more. By the time the chancre is noted, the spirochetes have already spread throughout the body and local treatment of the chancre alone will not suffice to cure the condition. If left untreated the chancre will usually heal completely within several weeks, and the patient may tend to disregard the condition, unaware that the disease is progressing unobserved within his body. Thus it is encumbent upon the Hospital Corpsmen to educate

crew members to report any suspicious sores of the genitalia and to follow up the condition until receipt of medical assurance that syphilis is either absent or that it is being properly treated. Unless otherwise informed, men may tend to disregard such "sores" as accidental scratches or insect bites, especially since they heal of their own accord; then, by the time the real significance of the condition is determined, serious damage may have occurred.

Following the appearance of the chancre, there occurs a period during which no other manifestations of the disease are noticed. The chancre may even disappear and the victim enjoys a period of false security. This frequently lasts from four to six weeks, although it may vary from a few days to many months. Then a number of manifestations appear to mark the secondary phase of the disease; there may be eruptions on the skin and mucous membranes, loss of patches of hair, pains in joints, or other symptoms. This secondary phase, if untreated, may last from three to ten weeks, to be followed by another "lull" (absence of obvious manifestations) for a period of months or years preceding the onset of the advanced phases of the disease.

Early detection of cases, and detection of all cases are important factors contributory to the control of syphilis. Crew members must have sufficient confidence in the Hospital Corpsman to come to him with their suspicions, and more than that, they should have sufficient advice from him to enable them to detect these symptoms. The Hospital Corpsman should note any physical symptoms together with the history of possible exposure to the disease. In addition, laboratory procedures are needed for conclusive diagnosis. These laboratory tests may include "darkfield" microscopic examination of material from the chancre, and serological tests ("blood tests") beyond the scope of the Hospital Corpsman. However, all suspected cases should be urged to have such tests performed as soon as possible (not waiting until the next routine "physical"). Serological tests are valuable not only in confirming an individual diagnosis, but also to aid in case-finding throughout the population. Pre-employment, pre-marital, pre-induction, and similar group examinations reach large numbers of people. All "positive" cases should be treated until such time as discontinuance is recommended by a physician; no person with a "positive blood" should fail to complete the full course of treatment by a physician. Periodic re-check should be made later to detect any recurrence.

A number of men with syphilis will rightly show concern over the danger to wives and offspring. Some seamen will worry a great deal, and the Hospital Corpsman may aid with sound advice. A man who

learns he has syphilis should refer his wife to her physician for a serological test and any treatments that may subsequently prove necessary. This is of particular importance if she is pregnant, since the disease may be transmitted to the unborn child. In such case, the disease is not "inherited" from either of the parents, but is actually transmitted by the infected mother to the fetus before birth. Almost always, adequate treatment of the pregnant woman can prevent syphilis in the unborn child.

Another venereal disease of prime importance is *gonorrhea*. It is caused by a specific micro-organism, Neisseria gonorrheae, which is a Gram-negative diplococcus more commonly called the "gonococcus." The gonococcus usually enters the body to establish infection by way of the genital tract, rarely elsewhere. Thus transmission is usually limited to sexual intercourse and rarely to eye infection through contamination of the eye with fresh discharges from the genitalia or eyes of an infected person. Fortunately the gonococcus is easily killed by drying and does not live long outside of the body; hence indirect transmission of this disease is unlikely.

In the male sex organs, the gonococcus enters almost exclusively through the urethra. The incubation period following exposure usually ranges from two to five days; by this time the bacteria have produced sufficient irritation and inflammation to cause pain or "burning sensation" during urination. Also, a conspicuous creamy pus discharge from the urethra will be noted. If gonorrhea is not treated early, it may lead to the formation of urethral strictures, or to complications by spreading deeper into the genito-urinary tract and involving the prostate gland, seminal vesicles, epididymis, testicles, or other structures.

Detection of gonorrhea is based upon the physical findings (notably the above-mentioned urethral discharge), the subjective symptoms revealed by the patient, plus history of recent exposure. Conclusive diagnosis can sometimes be made only upon study of gram-stained urethral smears and special laboratory culture of the suspected organisms in the urethral discharge.

Prevention of venereal diseases is based upon three major factors: (1) continence, or abstinence from casual sexual relations; (2) personal prophylactic measures; (3) social and educational measures.

Obviously, the most certain method the individual can apply for the avoidance of venereal disease is to refrain from all illicit or casual sexual relations. The individual can be offered every assurance that such restraint is quite "normal" and that it will in no way impair his sexual abilities or vigor. Every man should realize that almost all

prostitutes have gonorrhea or syphilis, and that many may suffer from both diseases; furthermore, the prostitute has little or no interest in the probable result that the man will become infected. "Pick-ups" are also very likely to be infected, since a woman "picked up" today was probably engaging in a similar performance yesterday and the days before also.

Personal prophylactic measures to avoid venereal diseases include (1) the use of a mechanical covering, the condom, (2) thorough washing of the genitalia and surrounding areas immediately after exposure, and (3) the use of chemical agents as quickly as possible to destroy microbes that may be present on the genitalia, genital area, or in the urethra. *All* of these measures should be used; no one of the steps alone offers the proper protection.

Mechanical protection is afforded by the use of a condom during sexual intercourse. The condom is a thin elastic sheath which fits snugly over the penis to form an unbroken protective layer over that organ. Condoms should be obtained from reliable sources only, since inferior condoms are frequently peddled. The condom should be placed over the penis before any contacts, and should it break during intercourse, prophylactic measures described below should be used immediately. The value of the condom is limited by the fact that it protects only the penis, while the adjacent areas may be exposed to infection. Thus, thorough washing of the entire area is indicated, to be followed by complete prophylactic treatment.

It is essential that the chemical phase of prophylaxis be utilized as quickly as possible following expsoure. Every extra minute of delay increases the risk. Chemical prophylaxis is most effective if applied within one hour after exposure.

The following procedure is based upon the use of the one-tube prophylactic kit which contains a number of chemical agents including calomel and sulfathiazole:

1. Urinate.

2. Wash the penis, scotum, pubic, and adjacent areas of abdomen and thighs, using plenty of soap and water. Proper cleaning will take several minutes. Particular care should be taken to wash the frenum and foreskin areas. For convenience, the kit contains a cloth saturated with soap.

3. After washing, dry the parts thoroughly.

4. Inject a portion of the contents of the ointment tube into the urethra and massage upward.

5. Rub the remainder of the ointment into the surface of the penis, with particular attention to the prepuce, frenum, and glans penis. Rub some ointment on the scrotum and surrounding surface as well. This operation, if administered with proper care, should require ten minutes. Ointment may be allowed to remain; it will not stain clothing.

6. Further urination should be delayed for four to five hours to allow full effects of the ointment in the urethra.

The above prophylactic procedure may be administered by the Hospital Corpsman on the ship, or by the individual himself immediately after exposure, or at prophylactic stations ashore. The Hospital Corpsman should instruct his crew in the proper use of prophylactic measures. If the individual himself has the knowledge and materials, delay can be avoided and this is a most valuable asset. On the other hand, if the individual is intoxicated or careless, the Hospital Corpsman or prophylactic station can provide more skilled attention.

The Hospital Corpsman should not only acquaint his crew members with knowledge of prophylactic measures, but should also provide basic information regarding sex hygiene, the nature of venereal diseases, and general preventive measures. The values of continence and self-control may be stressed. At all times, the Corpsman must maintain a restrained scientific attitude toward this subject; failure to maintain a serious attitude will result in loss of respect from the men.

Chapter III

DRUGS AND MEDICAL PREPARATIONS

With the exception of a few preparations, most drugs are given for a specific action rather than for the cure of an illness. The treatment of any illness includes many procedures in addition to the administration of medicine and, in most instances, more than one medicine is given. While the following preparations all have specific actions, these are limited in extent and may be completely nullified under certain adverse conditions. Before the Hospital Corpsman can efficiently administer these preparations, he must thoroughly understand their limitations as well as their actions. Until he acquires this proficiency, he should carefully analyze the effects of each drug used and not expect an immediate and striking response following its administration. Nor should the Hospital Corpsman give medicines merely to pacify a patient since this will lead to a false sense of security on the part of the Hospital Corpsman and may result in serious consequences due to his failure to investigate further into the patient's illness.

Before any medicine or preparation is given, the Hospital Corpsman must make certain that he is actually giving the medicine or preparation that he intends to give. He must also carefully measure the dose and be certain that the dose administered is the proper one. All bottles containing medicine must be carefully and legibly labelled and the labels of those bottles which contain mixtures of drugs should show the formula used in preparing the contents of the bottle. Bottles containing poison should be separated from all other medicines. These bottles should be distinctive in shape and color and should be labelled "Poison". No more than one day's supply of any medicine should be given to a patient and, in most instances, the Hospital Corpsman will find that the most satisfactory way to administer a medicine is to dispense it dose by dose and insist that the patient take the medicine in his presence. It is only by this means that he can be certain that the medicine has been taken.

For the convenience of the Hospital Corpsman, the following preparations have been grouped according to their effect on the various systems of the body and sub-grouped in accordance with their effect on that particular system. Example: sodium bicarbonate is listed under

Antacids, which are grouped with the drugs affecting the Digestive System. Since sodium bicarbonate has other actions, it is again listed under the headings appropriate for these actions.

DIGESTIVE TRACT

ANTACIDS

These drugs tend to relieve heartburn, biliousness and indigestion by neutralizing excess acidity of the stomach.

SODIUM BICARBONATE

(Bicarbonate of Soda, Soda, Baking Soda)

Form	Package	Average dose
White powder	One pound	1 teaspoonful in a glass of water.

ACTION

Sodium bicarbonate neutralizes acids by a chemical action. It is a harmless drug in the dose prescribed.

USES

1. For *heartburn* and *indigestion*, single doses may be used. If these conditions tend to recur, it may be used, but aluminum hydroxide is preferred.

2. For *persistent stomach pain* occurring daily after each meal or at night, give a half teaspoonful with a half teaspoonful of bismuth subcarbonate. These two drugs together give more prolonged relief from stomach pain caused by hyperacidity.

ALUMINUM HYDROXIDE

(Aluminum Hydroxide Gel, Aluminum Hydroxide Tablets)

Form	Package	Average dose
Thick liquid gel	12 oz. bottles	2 teaspoonfuls every 2 hours as needed.
Tablets	Bottle of 100 tablets	2 tablets (well-chewed) every 2 to 4 hours, as needed.

ACTION

Aluminum hydroxide neutralizes stomach acids by a physical action, adsorption. It also acts as a soothing coat to the stomach and intestinal lining. Its action is prolonged for several hours. Since it is harmless to

use, aluminum hydroxide is preferred when stomach pains tend to be chronic.

USES

1. For simple *heartburn*, give as needed.

2. For *gnawing stomach pains* which occur after every meal or at night, give every two hours throughout the day and as needed during the night.

If relief of stomach pains is incomplete, give one teaspoonful of sodium bicarbonate in addition.

ANTI-DIARRHEA DRUGS

These drugs tend to be constipating. For that reason they are used to decrease the frequency of bowel movements, if that is desirable. They do not remove the cause of the diarrhea.

BISMUTH SUBCARBONATE

Form	Package	Average dose
White powder	One pound	1 teaspoonful in ½ glass water at least every 2 hours.

ACTION

Bismuth subcarbonate has a soothing action on irritated stomach and intestinal linings. In addition, it reduces intestinal contractions and thus reduces diarrhea.

USES

For *diarrhea* from food poisoning or other conditions in which the linings of the stomach and intestine are irritated, give as often as every half hour for four doses; then a dose with each bowel movement, if the diarrhea continues.

PAREGORIC

(Camphorated Tincture of Opium)

Form	Package	Average dose
Brown alcoholic solution	One pint	1 to 2 teaspoonfuls in ½ glass water every 2 hours, as needed.

ACTION

Paregoric has two actions desirable in the treatment of diarrhea. It decreases diarrhea by inhibiting intestinal motions, and it inhibits cramping pain. Its anti-diarrhea effect is better than bismuth subcarbonate, but paregoric has no soothing action on the intestinal lining.

CAUTION

Paregoric, when given in repeated doses, will cause mental dullness which may be undesirable with ambulatory patients doing certain types of work. This drug may be *habit forming*.

USES

For *frequent diarrheal stools,* which are accompanied by cramping pain and a feeling of exhaustion and which have been unchecked for a day or more, give repeated doses.

It is usually desirable to give bismuth subcarbonate with paregoric when food poisoning is suspected.

LAXATIVES

MAGNESIUM SULFATE
(Epsom Salts)

Form	Package	Average dose
Crystals	One pound	1 tablespoonful in 1/4 glass water.

MILK OF MAGNESIA

Form	Package	Average dose
Liquid suspension of white powder	One pint	2 tablespoonfuls.

PETROLATUM, LIQUID
(Mineral Oil)

Form	Package	Average dose
Clear, oily, tasteless liquid	One pint	1 tablespoonful night and morning.

OTHER LAXATIVES

The following preparations may be available. Their use is limited in that they are irritating and habit forming. They have more of a tendency to cause griping pains and to leave the person weakened.

Preparation	Average dose
Cascara Sagrada tablets	1 tablet.
Castor Oil	1 tablespoon.
Compound Cathartic pills	1 pill.

ACTION OF LAXATIVES

These drugs, also called cathartics or purgatives, cause a bowel movement by one of two means. They either change the bowel contents

to permit easier passage, or irritate the bowel to action. An attempt to treat sickness with laxatives "to keep the bowels open" is not justified.

CAUTION

Giving a laxative to a person who appears to have "just an upset stomach" may be dangerous.

USES

1. To *evacuate the bowel*, distended with accumulations, in order to relieve constipation.

2. To soften bowel contents to *permit bowel movements without straining*, in individuals who have painful hemorrhoids. Liquid petrolatum is recommended for this purpose.

NERVOUS SYSTEM

DEPRESSANTS

These drugs depress the perception of sensations to the extent that pains and aches are relieved (acetylsalicylic acid) or are allayed and sleep is promoted (barbiturates, paraldehyde).

ACETYLSALICYLIC ACID
(Aspirin, A.S.A.)

Form	Package	Average dose
5 grain tablet	1,000	10 grains every 3 to 4 hours.

ACTION

Aspirin acts to relieve aches and pains, and reduces fever.

CAUTION

Do not give in doses other than the above except under unusual conditions. Aspirin may cause stomach ache from stomach irritation. This may be relieved by giving sodium bicarbonate with the aspirin.

USES

To relieve *moderate headache,* aches in muscles and joints, and the general body weariness accompanying colds ,influenze and other systemic diseases, give as necessary. Aspirin will not cure these diseases but will merely make the patient more comfortable.

PARALDEHYDE

Form	Package	Average dose
Clear liquid with unpleasant taste and odor	One pint	1/4 ounce by mouth or 1/2 ounce by rectum.

ACTION

Paraldehyde is a relatively safe drug to use to dull pain and promote sleep since this preparation does not depress respiration to the extent other sedatives do.

USES

1. To quiet *delirious patients*, repeat in accordance to the severity of their condition. Repeat dose no more often than every two hours.

2. To *prevent convulsions*, give one hour to one half hour before convulsion is anticipated. If one dose is not sufficient, it may be repeated in half an hour. The taste can be disguised by mixing paraldehyde with cracked ice.

It is the preferred drug to use to quiet delirium following head injury.

PENTOBARBITAL, SODIUM

Form	Package	Average dose
½ grain tablets or 1½ grain capsules	200	Sedative dose: ½ to 1 grain every 4 hours. Hypnotic dose: 1½ to 3 grains.

ACTION

The barbiturates depress the central nervous system, and any degree of depression from slight sedation to deep coma may be obtained with the use of these drugs. They are therefore employed to produce calmness, to induce sleep, and to inhibit convulsions.

CAUTION

Do not give regularly over a period of days without a physician's order.

USES

1. To allay *nervousness and anxiety*, give sedative dose.

2. To relieve *sleeplessness*, give hypnotic dose.

3. To prevent repeated *convulsions* (epilepsy) give grains 1½ three times a day.

TOXICOLOGY

An overdose results in excessive central nervous system depression. Symptoms from overdose include muscular unsteadiness, slow and difficult speech and mental sluggishness which is progressive until unconsciousness develops. Further depression will cause slow, shallow breathing, lowered blood pressure and lowered body temperature. Unconsciousness may last for hours or two to three days.

Treatment consists of emptying the stomach if the overdose has been

taken within the past two hours. This can be accomplished by inducing vomiting or by gastric lavage. Attempt to stimulate the person with strong coffee to keep him awake. If coma develops, give intra-muscular injections of 1 ampul of caffeine sodium benzoate and 1 ampul of ephedrine hydrochloride. Breathing may become so slowed that it will stop and artificial respiration becomes necessary.

PHENOBARBITAL
(Luminal)

Form	Package	Average dose
¼ grain tablets or 1½ grain tablets	100	Sedative dose: ¼ to ½ grain every 4 hours. Hypnotic dose: 1½ to 3 grains.

ACTION

The same as pentobarbital sodium, with the exception that it is more slowly absorbed and more slowly excreted. Thus it is slower to take effect than pentobarbital sodium, and its effect is more persistent and may extend into the next day, leaving the patient somewhat sleepy.

CAUTION

Do not give repeated doses over a period of days without a physician's order.

USES

The same as pentobarbital sodium. If used as a hypnotic (to induce sleep), give an hour before bedtime. Because of its prolonged action, phenobarbital is preferred to pentobarbital sodium as a preventive for convulsions in epilepsy and as a sedative for anxiety and emotional stress.

SCOPOLAMINE
(Hyoscine)

Form	Package	Average dose
0.65 milligram tablet	100	Give 0.65 milligram (grain 1/100) about ½ hour before its effect is desired. Dose may be repeated in 8 hours.

ACTION AND USES

Scopolamine is somewhat effective in preventing the symptoms of motion sickness (including sea sickness) in many susceptible individuals. In order to accomplish this effect, it will be necessary to give this drug before the onset of symptoms. Once symptoms have developed,

this drug is relatively ineffective. No more than two doses should be given and the drug should never be used under conditions where mental alertness and sound judgment are required. Personnel aboard ships must learn to disregard, to a certain degree, the symptoms of sea sickness.

NARCOTIC DEPRESSANTS

The narcotic drugs listed below are obtained from opium. Opium is the dried juice of the poppy plant capsule, and contains about 25% active ingredients. The most important of these are morphine and codeine. Pantopon is a mixture of the active ingredients of opium and may be given orally or by injection. Dilaudid and demerol are synthetic narcotic drugs similar in action to morphine.

The Harrison Narcotic Law regulates the sale of opium and its derivatives and also of cocaine. There is a provision in the law which permits the sale of very small quantities of narcotic drugs without a physician's prescription. These quantities are as follows:

1. Opium, 2 grains or less per ounce of medicine.
2. Codeine, 1 grain or less per ounce of medicine.
3. Morphine, ¼ grain or less per ounce of medicine.

Narcotics must be kept under lock and key in the poison cabinet, in the sick bay safe, or in the Captain's safe.

Monthly reports covering the use of morphine and codeine are required. Since these reports include the name of the patient, diagnosis, duration of illness and amount of morphine or codeine administered, it is apparent that exact records must be kept.

Morphine and codeine are used chiefly to relieve pain. Mental dullness or stupor, similar to sleep, accompanies the pain relieving effect by depressing the higher centers of the brain. Morphine is more potent than codeine, but codeine does not depress breathing to the extent that morphine does.

CODEINE SULFATE

Form	Package	Average dose
½ grain oral tablets	50	To relieve pain: ½ to 1 grain with 10 grains of aspirin, which may be repeated in ½ hour. Subsequent doses may be given after 4 hours.

ACTION

Codeine inhibits moderate pain and cough stimuli, acting in about twenty minutes and lasting about two to four hours.

USES

1. To relieve *moderately acute pain* when aspirin alone is ineffective.

2. To control *severe cough* that is preventing sleep and is extremely tiring to patients whose recovery is jeopardized by this type of cough. It is not advisable to use codeine to prevent a cough that is removing secretions from the air passages.

3. To control *milder coughs*, mixtures containing 1 grain of codeine per fluid ounce may be given in teaspoonful doses every two hours.

TOXICOLOGY

Symptoms of an overdose are similar to those symptoms discussed below for an overdose of morphine, except that delirium may occur prior to coma. Treatment is the same as for an overdose of morphine.

MORPHINE SULFATE

Form	Package	Average dose
¼ grain hypodermic tablets	20	¼ grain, not to be repeated sooner than 45 minutes. Interval usually is 4 hours.

ACTION

Morphine is a potent drug for the relief of pain. When given hypodermically, its action begins in approximately twenty minutes and lasts nearly four hours. If given by mouth the action is considerably delayed and the effect reduced by approximately one half. Atropine in small doses is occasionally added to morphine tablets in order to lessen certain side effects morphine may produce. These tablets may be used in the same manner as morphine sulfate alone.

CAUTION

Certain actions of morphine are or may be undesirable. These are cerebral depression leading to unconsciousness and masking of symptoms, depression of respiration, and addiction.

1. Do not give morphine when mental dullness, unconsciousness or coma are present. In injuries under battle conditions, do not give it to a person whose pain is mild enough to permit him to walk to his bunk, as morphine will only make him so sleepy that he must be carried.

2. Do not give morphine to a patient who will be seen by a physician within eight hours, unless the patient's condition justifies the use of morphine despite the fact that it may confuse subsequent diagnosis.

3. Do not give morphine if respirations are less than 12 per minute

or when lips and skin are blue (cyanotic) as seen with congestion of the lungs, asphyxia or failing heart.

4. Do not give morphine at exactly four hour intervals. Rather, give it for pain only when needed. Do not continue its use longer than one week.

5. Do not give over a period of more than twenty-four hours unless so advised by a physician.

USES

1. To relieve only *severe pain* not apt to be relieved by other nervous system depressants. This degree of pain may accompany extensive injuries, fractures of large bones and burns over large areas.

2. To prevent or treat *shock* likely to occur following severe injuries. The use of morphine should be reserved for injuries such as a burn covering an area equal to the anterior surface of the chest, crushing injuries, and chest and abdominal injuries. These injuries are likely to produce shock even though the accompanying pain would not ordinarily require the use of morphine.

3. To relieve severe pain caused by disease of the internal organs, such as that associated with heart disease and kidney stones.

If the pain in the above conditions re-appears, it may be diminished enough to be controlled with codeine.

TOXICOLOGY

Mild toxic symptoms are nausea and vomiting in those sensitive to the drug. Symptoms of an overdose are slow breathing and stupor from which the person cannot be aroused. Morphine causes contraction of the pupils and this may give the clue to the cause of the stupor.

To treat an overdose of morphine, stimulate the person in an effort to counter-act the central nervous system depression. Keep him awake by walking and talking to him. Produce pain (without injury) by pinching the Achilles tendon and the skin or by inserting your finger nail under his. Give nervous system stimulants, such as 2 ampuls (3/4 grain) of ephedrine hydrochloride or 2 ampuls (15 grains) of caffeine sodium benzoate intramuscularly, and another ampul in two hours, if necessary. If breathing fails, artificial respiration must be started.

MORPHINE TARTRATE

Form	Package	Average dose
1/4 or 1/2 grain in syrette	5 syrettes per box	1/4 grain not to be repeated sooner than 45 minutes. Interval usually is 4 hours.

USES

A morphine syrette is a convenient package of morphine as it permits instant administration subcutaneously without waiting to boil instruments. For this reason, it is used in emergencies when there is great pain.

METHOD OF ADMINISTRATION

1. Remove the transparent hood.

2. Pierce the seal at the base of the needle by pushing the wire, present in the needle, through the seal. Discard the wire.

3. Push the needle into the disinfected skin of the arm and slowly squeeze the contents of the tube into the subcutaneous tissue.

STIMULANTS

Central nervous system stimulants increase the activity of the brain. A stimulant will arouse a person from unconsciousness and coma if the dose is sufficiently large and is given soon enough. It will make the person, who exhibits mental dullness, more alert. The same dose given to a normal person will make him more sensitive to pain; he will be nervous or "jumpy" and unable to sleep.

BENZEDRINE SULFATE

Form	Package	Average dose
5 milligram tablets	100	1 tablet not to be repeated sooner than 6 hours.

ACTION

Stimulation will begin in about one hour and will last from six to eight hours. Benzedrine sulfate is not a substitute for sleep and leaves the person feeling weary and "let down".

CAUTION

Do not give more than two successive doses without allowing person to sleep. Collapse may result. The drug may be habit forming.

USES

To temporarily relieve drowsiness when a man must remain on duty for emergency watch.

TOXICOLOGY

Symptoms of overdose or unduly prolonged use are nervousness, excitability, hallucinations, headache, loss of appetite, cramps, and irregular heart beat.

Treatment consists of 3 grains of pentobarbital sodium to induce sleep.

CAFFEINE SODIUM BENZOATE

Form	Package	Average dose
2 cc. ampul containing 7½ grains	12	1 ampul (7½ grains) injected subcutaneously or intramuscularly. May be repeated in ½ hour.

ACTION

It is a relatively safe brain stimulant to be used when nervous system depression is present. Action begins promptly and lasts several hours.

CAUTION

Do not give when acute pain is present.

USES

1. To counteract *stupor* and *coma* caused by an overdose of depressant drugs as morphine, codeine, pentobarbital sodium, phenobarbital, alcohol (whiskey, etc.) and gas poisoning. It is expected that sleep will follow the administration of depressant drugs. However, if symptoms of an overdose appear, stimulants are necessary.

2. To counteract *emergency collapse*, *shock* and *coma* accompanying serious injuries of the head and body, or serious illness.

(See Respiratory and Circulatory Stimulants.)

TOXICOLOGY

Symptoms of excessive doses are nervousness, insomnia, palpitation of the heart, pain over the heart, headache and perhaps nausea and vomiting.

Treatment consists of 3 grains of pentobarbital sodium or phenobarbital or ½ ounce of paraldehyde.

EPHEDRINE HYDROCHLORIDE

Form	Package	Average dose
⅜ grain per ampul	6	⅜ to ¾ grain subcutaneously.

ACTION AND USES

Ephedrine hydrochloride acts on the nervous system in a more powerful but somewhat similar manner to caffeine sodium benzoate.

(See Respiratory and Circulatory Stimulants.)

RESPIRATORY SYSTEM

BRONCHIAL DILATORS

EPHEDRINE SULFATE

Form	Package	Average dose
3/8 grain capsules	100	1 to 2 capsules (3/8 to 3/4 grain) with 1/4 grain of phenobarbital every 4 hours.

ACTION

Ephedrine relaxes the muscular spasm of the small air passages that produces the labored breathing in asthma. If the attack is severe, ephedrine may give only moderate relief. The central nervous system stimulation caused by ephedrine may be objectionable and is controlled by sedatives.

EPINEPHRINE HYDROCHLORIDE

(Adrenalin)

Form	Package	Average dose
1 cc. ampuls or 1 ounce vials	12 ampuls or 1 vial	1/2 cc. subcutaneously.

ACTION

Epinephrine is a more powerful bronchial dilator than ephedrine. Epinephrine acts more quickly, but the action does not last more than an hour.

CAUTION

Do not give epinephrine to persons with heart disease or high blood pressure.

USES

To relieve a *severe asthmatic attack,* epinephrine is preferred to ephedrine. The dose may be repeated in one half hour.

EXPECTORANTS

BROWN MIXTURE

Form	Package	Average dose
Lozenges	1000	1 lozenge dissolved in the mouth every 1 or 2 hours.

ACTION

This preparation is mildly soothing to an irritated throat and, in addition, tends to loosen secretions in the respiratory passages by making them more liquid. However, its beneficial properties are very limited.

CAUTION

Limit dose to 15 tablets in twenty four hours.

USES

To relieve throat irritation and to "loosen up" a cough.

COMPOUND TINCTURE OF BENZOIN

Form	Package	Average dose
Brown, sticky, alcoholic solution	1 pint	1 tablespoonful to 1 quart of steaming water.

ACTION AND USES

Tincture of benzoin has a mildly soothing action as an inhalant expectorant and lends a more pleasant odor to the steam inhaled for common cold irritations of the upper respiratory system. Caution should be exercised to avoid assigning to this preparation more beneficial properties than it actually possesses.

(See Skin Emollients.)

ELIXIR OF TERPIN HYDRATE WITH CODEINE

Form	Package	Average dose
Clear, aromatic liquid	1 pint	1 teaspoonful every 2 hours or a total of 2 ounces per day.

ACTION AND USES

Elixir of terpin hydrate is beneficial in the treatment of a cough since it is soothing to the irritated mucous membranes, has a slight tendency to diminish the quantity of sputum and because its codeine content tends to inhibit the impulses that cause the cough. To be fully effective, this preparation should be given in repeated small doses and not at the time of the coughing attack.

SYRUP OF WHITE PINE WITH CODEINE

Form	Package	Average dose
Brown syrup	1 pint	1 teaspoonful every 2 hours or a total of 2 ounces per day.

ACTION AND USE

There are three components of this preparation which have beneficial action in relieving coughs. The codeine inhibits cough-producing impulses. White pine liquifies thick secretions in the air passages. The syrup temporarily soothes the throat where many cough impulses arise. To be effective, this preparation must be given in frequent small doses. It does not remove the cause of the infection in the respiratory passages.

This preparation may be provided without codeine and is an effective substance for the treatment of a cough.

STIMULANTS

AROMATIC SPIRITS OF AMMONIA

(See Circulatory Stimulants)

ACTION AND USES

Aromatic spirits of ammonia is useful to relieve a temporary stoppage of breathing through its reflex stimulating effect on the respiratory center.

CAFFEINE SODIUM BENZOATE

(See Nervous System and Circulatory Stimulants.)

ACTION

Caffeine sodium benzoate exerts its action through a direct stimulating effect on the medullary centers. It is a more powerful and more prolonged respiratory stimulant than aromatic spirits of ammonia.

USES

To improve *feeble respirations,* give 1 ampul, 7½ grains, by subcutaneous injection.

EPHEDRINE HYDROCHLORIDE

(See Nervous System and Circulatory Stimulants.)

ACTION

Ephedrine hydrochloride exerts a direct stimulating effect on the respiratory center. It is the most powerful of the three respiratory stimulants listed. Its effect is prompt and persists for approximately two hours.

USES

1. To relieve *temporary cessation of breathing,* give ¾ grain by subcutaneous injection in conjunction with artificial respiration.

2. To counteract overdoses of *respiratory depressant drugs,* give ¾ grain dose and repeat as necessary.

CIRCULATORY SYSTEM

VASODILATORS

AMYL NITRITE

Form	Package	Average dose
Glass ampuls with cloth covering	12	1 ampul crushed and contents inhaled.

ACTION

Amyl nitrite promptly dilates blood vessels permitting an increase of circulation. In this way pain associated with spasm of the arteries is relieved. Amyl nitrite also lowers blood pressure, and for this reason may cause severe dizziness and faintness. The effect of the drug lasts for only a few minutes. Another ampul may be used as soon as the effects of the first dissipate.

USES

To relieve sudden, sharp, *intense pain over the heart* when this pain is of a transitory nature. If the pain remains intense with no apparent relief, stop amyl nitrite, since the pain is probably not caused by arterial spasm. Under these conditions, give morphine.

NITROGLYCERIN

Form	Package	Average dose
1/150 grain tablet	20	1 tablet, 1/150 grain held under the tongue. May be repeated at ½ hour intervals as needed.

ACTION AND USES

Nitroglycerin acts in the same manner and is used to treat the same conditions as amyl nitrite. Since the absorption of nitroglycerin in the mouth is slightly delayed, the maximum effect of this drug is not obtained until two or three minutes after its administration. Its action is more prolonged than amyl nitrite and in 1/150 grain doses, it does not cause dizziness and faintness.

STIMULANTS

AROMATIC SPIRITS OF AMMONIA
(Smelling Salts)

Form	Package	Average dose
Clear aromatic liquid	8 ounce bottle	By inhalation — small quantity on cotton or gauze. By mouth — ½ teaspoonful in ½ glass of water every ½ hour for 3 doses.

ACTION

Ammonia in dilute concentration acts as a reflex stimulant of the vasomotor and respiratory centers through its irritating effect on sensory nerve endings.

USES

1. To relieve *syncope* (fainting), give by inhalation.
2. To relieve mild, shock-like states where the degree of injury and pain is too mild to explain the symptoms, give by mouth.

CAFFEINE SODIUM BENZOATE
(See Nervous System and Respiratory System Stimulants.)

ACTION AND USES

Caffeine sodium benzoate exerts its beneficial effect in circulatory collapse chiefly through its action on the central nervous system and respiratory system.

EPHEDRINE HYDROCHLORIDE
(See Nervous System and Respiratory Stimulants.)

ACTION AND USES

Ephedrine hydrochloride affects the cardiovascular system chiefly by peripheral vasoconstriction, and by increasing the cardiac output, blood pressure and pulse rate. Its usefulness to the Hospital Corpsman as a circulatory stimulant is extremely limited and it should be used only upon the advice of a physician. This drug should not be employed in the treatment of shock.

EPINEPHRINE
(See Bronchial Dilators.)

ACTION AND USES

The effect of epinephrine on the circulatory system is very similar to that of ephedrine. Its action, however, is more prompt, more power-

ful but more transitory. It should not be used for its cardiovascular effect unless prescribed by a physician.

DRUGS WHICH SUPPORT THE CIRCULATION

These preparations may be given intravenously or subcutaneously, as directed in the following paragraphs. Their beneficial action on the circulatory system is achieved by increasing the volume of the circulating blood or by improving its quality. They may be administered singly or in combination, or to supplement fluids given by mouth or by rectum.

BLOOD PLASMA

Form	Package	Average dose
Yellow powder	250 cc. unit	250 cc. intravenously at maximum rate of flow.

ACTION

Blood plasma is the liquid portion of normal human blood and is the intravenous liquid of choice to increase blood volume and enable the circulation to become more efficient. It has the property of staying in the circulatory system when water by mouth or by vein tends to leak out into the tissues. This property of plasma is particularly desirable when the capillaries have been rendered more permeable. Unlike intravenous solutions, blood plasma tends to hold water in the circulatory system and thus prevents concentration of the blood and loss of normal blood volume.

USES

1. To prevent *primary shock* associated with severe burns, and severe injuries involving bone and large quantities of soft tissue, give 250 cc. (1 unit) immediately.

2. To treat *hemorrhage* and *secondary shock* give plasma in 250 cc. (1 unit) quantities, repeated as necessary, to revive circulation. The increased blood volume raises the blood pressure, thus restoring the circulation to normal.

3. To treat *severe burns,* give plasma to relieve shock and to replace that plasma which has escaped from the capillaries. The amount of edema in the burn area and the amount of exudate from the surface are equally as important as the condition of the patient in judging the amount of plasma necessary. If the burn involves 10% of the body surface, the patient should receive 1000 cc. of plasma within the first twenty four hours after injury. This quantity or more should be re-

peated daily during the first three days or longer, depending upon the patient's condition. A burn involving 20% of the body surface should receive 2000 cc. of plasma every twenty four hours. To treat burns involving larger areas, increase the quantity of plasma in proportion to the burn.

4. To treat severe illnesses, if there is a deficient protein intake or prolonged protein loss, give plasma in 250 cc. quantities as directed by a physician.

INTRAVENOUS SOLUTIONS

Form	Package	Average dose
Normal saline or 5% glucose in normal saline	1000 cc. flasks	1000 cc. intravenously at a rate of 90 to 120 drops a minute.

ACTION

While these preparations increase blood volume, this effect lasts for a shorter period of time than that of plasma, since they tend to pass out of the blood within a few hours. This may be an advantage over plasma, since these solutions will quickly replace tissue fluid which has been depleted by vomiting, diarrhea or lack of fluid intake. This characteristic is undesirable if edema already exists. Glucose solutions supply nourishment in addition to water.

USES

1. To treat *shock*, give intravenous glucose or normal saline if plasma is unavailable.

2. To prevent and treat *dehydration* in the presence of severe vomiting, diarrhea, or lack of fluid intake, give 1000 cc. of normal saline in the morning and 1000 cc. of 5% glucose solution in the afternoon in addition to oral fluids. If dehydration is still present, increase the quantity to maintain the urinary output at or slightly above 1000 cc. daily. To maintain the urinary output at this level, it may be necessary to give 4000 to 5000 cc. daily.

3. In the treatment of *severe illnesses* associated with high degree of toxicity and fever, the administration of 1000 to 2000 cc. daily of these solutions is desirable. They supply necessary salts, water and nourishment which are probably being ingested in inadequate amounts.

SKIN

ANTISEPTICS

These skin preparations are liquids, ointments, or powders. They are useful in ridding the skin surface of excessive bacterial contamination, but do not completely sterilize the skin surface.

The action of antiseptics is limited to the superficial layer of cells to which they are applied. For this reason, it is useless to apply antiseptics to infected areas involving more than the most superficial layer of cells. For example, it is useless to paint an antiseptic on a pimple or boil since the seat of infection is much deeper than the antiseptic is able to penetrate.

The inability of antiseptic preparations to penetrate necessitates the removal of accumulations of dry pus, mucus and other crusts, so that the antiseptic may reach the infected tissue. Crusts may be removed by soaking and washing with soap and water.

Draining or "weeping" skin conditions are best treated by powder or liquid preparations. Thin layers of ointments are applied to infected areas in order to provide drainage of pus from the wound to the gauze compress. Excessive quantities of ointment or ointments which do not melt at skin temperature defeat this purpose. The antiseptic content of the ointment is relatively ineffective.

Sulfonamide powders or crystals and the liquid antiseptics are more effective as prophylactic agents, but have limited value in the treatment of superficial infections. Sulfonamide powder is rendered ineffective by the presence of large quantities of pus. Topical application of penicillin in conjunction with its use intramuscularly or in conjunction with the oral administration of sulfonamides is effective in the treatment of open infections even in the presence of pus, but does not have the ability to penetrate the skin to a closed infection.

ALCOHOL

Form	Package	Method of application
70% denatured ethyl alcohol	1 pint	Cleanse the skin by rubbing with a saturated sponge.

ACTION

Alcohol when applied to the clean skin in the usual manner accomplishes a limited, but satisfactory disinfection. Since alcohol is volatile, it leaves the skin quickly in contrast to other antiseptics.

CAUTION

1. Denatured alcohol contains poisons which will produce severe gastro-intestinal disorders. It should not be taken by mouth.

2. If the skin is dirty, it should be washed with soap and water before applying alcohol.

USES

1. To prepare the skin for hypodermic injection and venipuncture.

2. To prepare the skin for smallpox vaccination. Be sure that all alcohol has evaporated before applying the vaccine.

(See Disinfectants)

IODINE, TINCTURE OF, MILD

Form	Package	Method of application
Brown, alcoholic solution	4 ounce bottle	Apply to skin with applicator.

ACTION AND USES

Mild tincture of iodine is a relatively non-irritating substance when applied to the skin, popularly used to prevent infection of minor skin injuries. Tincture of iodine tends to concentrate with time through the evaporation of alcohol and its irritating and caustic actions are thus increased. An extremely irritating effect is produced when iodine is used in conjunction with mercurial preparations. Because of these actions, its use by the Hospital Corpsman is not recommended.

OTHER SKIN ANTISEPTICS

The following preparations are listed under the trade names of their manufacturers and have been accepted by the Council on Pharmacy and Chemistry of the American Medical Association. These, and other preparations that will undoubtedly be developed in the future, are suitable as skin antiseptics. Some are supplied as aqueous solutions, others as tinctures, and still others in both forms. They may be colorless or colored.

1. Mercurochrome
2. Merthiolate
3. Metaphen
4. Merphenyl Nitrate
5. Merphenyl Picrate
6. Merphenyl Borate
7. Zephiran Chloride or Phemerol

ACTION

The above preparations when applied to the skin in the usual manner, accomplish a limited but satisfactory disinfection. In contrast to alcohol, which is volatile and thus exerts its action for a relatively short period of time, these preparations remain on the skin and exert

a disinfecting action over a longer period of time. They are all relatively non-irritating to the skin.

CAUTION

Do not use these preparations for disinfecting the skin prior to smallpox vaccination.

USES

To disinfect the skin prior to incising the skin.

SULFANILAMIDE POWDER

Form	Package	Method of application
White powder	5 gram envelopes	Sprinkle thin layer over surface.

ACTION

Sulfanilamide inhibits the growth of certain organisms found in open wounds. This action enables the body defenses to overcome the offending infectious organism more easily. Infection may develop even if sulfanilamide is applied to the fresh, uninfected wound; but the infection is usually minimal and superficial. Sulfanilamide will not penetrate the unbroken skin. Even on open wounds, it is most effective on superficial types where deep penetration is not necessary. The effectiveness of sulfanilamide powder is reduced by the presence of pus, partly because the pus keeps the powder from the infected tissues and partly because pus inactivates sulfa drugs.

It is necessary to practice sterile technique, to provide adequate drainage of the wound, and to use other recommended measures in the treatment of wounds, even though sulfanilamide powder is used.

Sulfadiazine powder and sulfathiazol crystals may be used in place of sulfanilimide powder. Sulfathiazol powder is undesirable since it tends to cake. The sulfonamide drugs, when applied locally, cannot be expected to control deep-seated or spreading infections. These infections require systemic treatment. If sulfonamides are used, they are given by mouth.

CAUTION

1. Sulfanilamide powder should be dusted on the area in a very thin layer. If the layer is too thick, it tends to cake. This irritates the wound and retards healing.

2. A few people will be sensitive to sulfa drugs. If inflammation and edema develop within twenty four hours after applying sulfanilamide powder to a surface, it is probably caused by sensitivity to sulfanilamide and the drug should be stopped.

3. Do not apply more than 10 grams (two envelopes) on the wounds of one person within a twenty four hour period.

USES

1. To prevent infection in burns, abrasions, large and deep lacerations, compound fractures and war wounds, dust a thin layer over the surface of the wound that has been cleaned.

2. To treat acute, superficial skin infections which produce pus, remove the pus and dried crusts and dust on a thin layer.

3. To treat penile ulcers, clean ulcer with boric acid solution and apply sulfanilimide powder.

SULFATHIAZOL OINTMENT

Form	Package	Method of application
White ointment	1 pound jars	Apply a thin layer 1 to 3 times daily.

ACTION AND USES

Sulfathiazol ointment exerts its beneficial action through the properties of its ointment base and sulfathiazol content. It is effective in the treatment of acute superficial skin infections that produce pus. All crust must be removed before the application of the ointment, if it is to be effective.

PENICILLIN

(See Systemic Infections)

ACTION AND USES

Penicillin in the strength of 500 units per cc. of water or normal saline is a non-irritating and powerful skin antiseptic. To be fully effective, it must remain in contact with the infected area for at least thirty minutes and treatment should be repeated four times a day. Continuous application is preferable. This may be accomplished by irrigating the area with 1 to 10 cc. of penicillin solution, collecting the overflow with sterile gauze compresses, and using these compresses as a wet dressing until the next irrigation. Unlike the sulfonamides, penicillin is not inactivated by pus. However, crusts and excessive quantities of pus act as a mechanical barrier and should be removed. Penicillin will not penetrate the unbroken skin and is thus of no value when applied topically in the treatment of closed infections. The topical application of penicillin will be found effective in the treatment of open, superficial skin infections and infected, shallow wounds.

CAUTION

Do not use penicillin to treat penile ulcers.

POTASSIUM PERMANGANATE

Potassium permanganate has been used in solution form for the treatment of superficial, chronic skin infections, "athletes foot" or "ringworm," and superficial skin ulcers. It has not proved to be an effective germicide and its use as a skin antiseptic by the Hospital Corpsman is not recommended. Potassium permanganate solution, 1:5000, is effective as a detoxifying agent in the early treatment of ivy poisoning.

COUNTERIRRITANTS

OIL OF WINTERGREEN
(Methyl Salicylate)

Form	Package	Method of application
Clear liquid with an aromatic odor	1 pint	Rub on skin as required.

CAMPHOR AND SOAP LINIMENT

Form	Package	Method of application
Soapy liquid	1 pint	Rub on skin as required.

CHLOROFORM LINIMENT

Form	Package	Method of application
Clear liquid with penetrating odor	1 pint	Rub on skin as required.

ACTION AND USES

These preparations are widely used as counter-irritants for the relief of pain, particularly that associated with strains, and sprains, and muscular aches and pains. Their effectiveness, however, is quite limited and the massage that accompanies their application is more effective than the substance itself. The application of heat, wet or dry, is much more effective as a counter-irritant than these preparations.

RUBBING ALCOHOL
(See Skin Antiseptics)

ACTION AND USES

Rubbing alcohol has little or no counter-irritant effect but it is

cooling to the skin since it readily evaporates. It is an effective lubricant for massage purposes.

EMOLLIENTS

Emollients are used to soothe and soften the skin. In addition, they prevent drying of the skin, thus avoiding irritation.

PETROLATUM, SOLID
(Vaseline)

Form	Package	Method of application
Translucent ointment	1 pound	Apply a thin layer to the skin or to a gauze dressing.

ACTION

Petrolatum has all the properties of an emollient and is non-irritating. Being a semi-solid type of preparation, it adheres better than oil, so that two to three applications a day will keep the skin covered. As a base for other ointments, it will contribute emollient properties to those ointments. In many of these ointments, the chief beneficial action is derived from the petrolatum.

CAUTION

Do not apply large quantities of ointments to skin lesions. Thick layers of ointment prevent adequate drainage and cause the spread of an infection. This precaution applies to the use of all ointments.

USES

1. To help prevent *frost-bite, windburn, sunburn* or *immersion foot,* spread a layer on the exposed skin as often as is necessary to keep the skin coated at all times while the threat of these conditions is present.

2. To prevent contamination and irritation of *burns* and *abrasions,* apply a thin layer of petrolatum on gauze to the area.

3. To treat *skin conditions,* which are irritated by drying or by constant brushing by clothing, apply petrolatum on gauze to the skin.

BORIC ACID OINTMENT

Form	Package	Method of application
White or yellow ointment	1 pound	Apply a thin layer to the skin or to a gauze dressing.

ACTION AND USES

The principle beneficial action of this ointment is from the petrolatum base. In addition, the 10% boric acid content gives the preparation slight antiseptic properties. It may be used interchangeably with petrolatum but it is preferred in the treatment of superficial skin infections.

ZINC OXIDE OINTMENT

Form	Package	Method of application
White, pasty ointment	1 pound	Apply a thin layer which may or may not be covered with gauze.

ACTION AND USES

Zinc oxide ointment is particularly desirable as a soothing, softening and protecting ointment since both zinc oxide and the petrolatum base have this beneficial action. It is the ointment of choice in the treatment of most non-purulent and non-weeping, irritated skin lesions. It is also valuable to soften the edges of healing wounds and ulcers, and to soften dry, calloused or cracked skin.

PETROLATUM, LIQUID
(Mineral Oil)
(See Laxatives)

ACTION

Liquid petrolatum softens and prevents drying of the skin. It penetrates the skin better than solid ointment, but does not adhere as well.

USES

1. To cover irritated areas about the nose, lips and eyelids or small burned areas which are too small to require bandaging apply liquid petrolatum.
2. To soothe sunburned areas, apply small quantities.

CALAMINE LOTION

Form	Package	Method of application
Pink lotion also prepared with 1% phenol	1 pint	Paint on with cotton or gauze.

ACTION

Calamine lotion dries, leaving a protective, adherent coat. It is effective to relieve skin itching and irritation, associated with non-purulent, non-weeping, irritated skin conditions. The addition of

phenol makes the preparation more effective for the relief of itching as well as making it mildly antiseptic.

CAUTION

Always shake mixture thoroughly before using. This is particularly desirable if the preparation contains phenol.

USES

To relieve moderate itching and burning in skin conditions such as dermatitis, hives, insect bites, itching associated with measles and chickenpox, apply to the lesion as often as necessary. Should intense itching continue after the application of calamine lotion, it may be necessary to apply anesthetic skin ointments or occasionally to give sedative doses of drugs containing barbital derivatives. In the presence of itching, always consider the possibilities of scabies or pediculosis.

COMPOUND TINCTURE OF BENZOIN

(See Expectorants.)

ACTION AND USES

Compound tincture of benzoin contains a gum which forms a protective coat when the alcohol evaporates. This property makes it a suitable preparation for the protection of irritated surfaces, such as chafed thighs. It is likewise useful to prevent irritation, such as that caused by adhesive tape.

STARCH

ACTION AND USES

Starch is a tenacious, protective and soothing covering for irritated skin surfaces. It is ordinarily applied as a cornstarch bath or as an oatmeal bath. Starch is particularly effective to relieve the irritation associated with heat rash and other diffuse, non-purulent skin eruptions.

TALCUM POWDER

ACTION

Talcum powder is a bland and mildly soothing preparation which tends to keep skin surfaces dry and reduces friction of adjacent skin areas.

USES

1. Dust on the skin to reduce the irritation associated with heat rash and chafing.

2. To prevent burning sensation of the feet, dust on the feet and into the socks.

PARASITICIDES

Parasiticides are preparations which kills insects. Since each preparation is effective only against a particular type of invading insect, several preparations are necessary. Treatment will be most successful when the skin condition is accurately identified and the appropriate parasiticide is used.

BENZYL BENZOATE EMULSION

Form	Package	Method of application
White emulsion	4 ounces	Apply to skin in the recommended manner.

ACTION

Benzyl benzoate emulsion will rid the body of the organism causing scabies. It must be remembered that the skin eruption of scabies require a few days to disappear even though the insect has been destroyed. Benzyl benzoate emulsion does not adequately rid the clothing of the insect.

USES

To treat *scabies*, dilute the 50% emulsion with an equal part of water. Four ounces of the diluted solution is usually sufficient for one application.

CUPREX

Form	Package	Method of application
Clear, oily smelling liquid	1 pint	Apply sparingly to the infested area and wash off in 20 minutes.

ACTION AND USES

Cuprex is a proprietory preparation effective against lice and their eggs (nits). It is irritating to the skin, and is ineffective in ridding the clothing of lice and nits.

DICHLORO-DIPHENYL-TRICHLOROETHANE (D.D.T.) POWDER

Form	Package	Method of application
10% D.D.T. in inert powder	2 ounce tins	Sprinkle on the infested area.

ACTION AND USES

D.D.T. powder is effective in killing many types of insects which attack the skin. It does not kill immediately on contact, but requires several hours to take effect. On the other hand, once applied to the body or clothing, it will be effective in ridding the body of insects for a period

of days. To rid the body of lice, sprinkle a generous amount on the affected area and distribute evenly. Blow the powder on the inner surface of garments, particularly into the under side of the seams if the clothes cannot be laundered promptly.

DICHLORO-DIPHENYL-TRICHLOROETHANE (D.D.T.) SPRAY

Form	Package	Method of application
D.D.T. in suitable solvent	1 gallon	High pressure, fine spray.

ACTION AND USES

Certain insects which attack the skin such as bedbugs, flies and mosquitoes, are best controlled by eradicating them from the environment when possible. D.D.T. spray will eradicate insects from sleeping quarters, living quarters, and gear lockers and prevent re-infestation for a period of several weeks. To be effective it should be sprayed thoroughly on all surfaces and into all cracks and crevices.

PYRETHRUM SPRAY

This preparation is an effective agent for the elimination of the adult form of insect life. Its effectiveness is due to its pyrethrum content as well as its petroleum base. In contrast to D.D.T., its effect is almost immediate but only lasts a few minutes. This is the common, commercial type of insect spray.

INSECT REPELLENTS

There are several commercial preparations that are effective in repelling insects. These preparations are used to protect the individual against insect bites when the insects cannot be eradicated from the environment. They are applied to the exposed skin and around openings in the clothing, shoes and socks.

Their chief use is for protection from biting flies, gnats, mosquitoes, fleas, ticks, and mites. The action of skin repellents lasts for a short period of time and their application must be repeated if continued protection is desired.

SKIN CLEANSERS

CARBON TETRACHLORIDE

Form	Package	Method of application
Clear volatile liquid	1 pound	Clean with saturated applicator.

ACTION AND USES

Carbon tetrachloride is an effective fat solvent and, as such, is used to remove grease from superficial wounds as well as to remove the

residue remaining on the skin after the removal of adhesive tape. It is somewhat irritating to inflamed skin. It evaporates quickly, leaves no residue and is non-inflammable.

DETERGENT EMULSION

Form	Package	Method of application
Liquid	1 pint	Saturate gauze applied to area.

ACTION

These preparations are effective for the removal of grease and oil and in addition are non-irritating to the denuded skin.

USES

To remove oil from large, burned areas or large wounds, apply gauze, saturate it with detergent emulsion, allow to remain for one half hour, and repeat the process if necessary. This method of removing grease and oil requires no rubbing of damaged tissue.

TINCTURE OF GREEN SOAP

Form	Package	Method of application
Green, soapy liquid	1 pint	Apply dilute solution (1 tablespoon of soap to 1 pint of water).

ACTION AND USES

The action of green soap is chiefly cleansing. It is a useful form of soap for cleansing the skin around infected wounds. To clean crusts from infected skin lesions, soak with full strength solution and remove.

SURFACE ANESTHETICS

BENZOCAINE OINTMENT

Form	Package	Method of application
Ointment	2 ounces	Apply a layer of ointment to the affected surface.

ACTION

Benzocaine has the ability to penetrate the superficial layers of the skin and produce a mild degree of anesthesia. Failure of this ointment to be completely effective will often occur when the source of pain is too deep. The persistance of the anesthetic effect is dependent upon the quantity of ointment applied.

USES

1. To relieve itching, burning sensations, and moderate pain of first degree burns or hemorrhoids, apply as directed.

2. It may be combined with various skin ointments when anesthesia is desirable in addition to the action of the skin ointment.

SODIUM BICARBONATE

(See Antacids)

Sodium bicarbonate made into a paste with water, while not an anesthetic, will relieve the itching of most insect bites by neutralizing acid deposited in the skin.

OTHER SKIN PREPARATIONS

FOOT POWDER

Formula		Package	Method of application
Salicylic acid	5 grams	1 pound	Sprinkle on feet.
Zinc stearate	5 grams		
Boric acid	5 grams		
Powdered talcum	75 grams		
Starch	100 grams		

ACTION

This preparation is mildly fungicidal and in addition acts as a drying and emollient agent.

CAUTION

Some people are sensitive to salicylic acid. If redness and slight swelling of the skin to which the powder has been applied develops within a day after applying the powder, do not use this preparation or any preparation containing salicylic acid.

USES

For limited cracking and peeling of the skin between the toes and for red skin eruptions between the thighs, particularly when these skin surfaces are continually moist from sweating, dry skin well and sprinkle on a generous amount of the powder. If the feet are involved, sprinkle the powder into the socks. If sweating is excessive and the powder tends to cake, the area should be washed and the powder applied three times a day.

WHITFIELD'S OINTMENT, HALF STRENGTH

Form	Package	Method of application
White ointment	1 pound	Apply very sparingly.

ACTION

This is the standard Whitfield's ointment, to which has been added an equal amount of petrolatum. The preparation contains a fungicide and is widely used in the treatment of ringworm and other fungus infections. It causes desquamation (scaling off) of the skin and is quite irritating after a few days application. It should not be applied to skin that is more than very mildly inflamed and its use should be discontinued after seven days but may be resumed a week later.

USES

1. For *"athlete's foot"* or those conditions characterized by cracking and peeling of the skin between the toes and of the skin of the foot, clean and dry the feet and apply daily a thin layer of the ointment sufficient only to make the skin shiny.

2. For *"ringworm"* or those conditions which spread slowly and tend to heal in the center, apply a thin layer of the ointment daily for seven days.

3. For removal of a *painful callus* usually found on the ball of the foot, rub the ointment well into the skin morning and night. As the dead skin softens and tends to loosen, peel it off to permit better penetration of the ointment.

EYE, EAR, NOSE, MOUTH, AND THROAT

ANESTHETICS

BUTYN

Form	Package	Average dose
Ointment	1 dram ophthalmic ointment tube	Squeeze on the lower lid as needed.

ACTION

Butyn ophthalmic ointment is usually prepared with the addition of a mild antiseptic. It is an effective surface anesthetic for the eye and, as such, is capable of relieving pain of superficial origin. Its action persists for approximately one hour.

CAUTION

1. Cover the anesthetized eye to prevent further injury.
2. Do not use eye anesthetics for more than three consecutive days.

USES

1. To relieve *eye pain* associated with diseases and injuries of the eye, apply and repeat as necessary.
2. Pain that is not relieved by this preparation will require the use of hot or cold compresses and, in some instances codeine sulfate.

TETRACAINE HYDROCHLORIDE
(Pontocaine)

Form	Package	Average dose
Clear liquid	1 ounce dropper bottle	2 drops.

ACTION AND USES

One half percent tetracaine hydrochloride solution produces anesthesia in about thirty seconds, but the effect persists for less than a half hour. Therefore, this preparation is superior to anesthetic ophthalmic ointment when only a single application is necessary. It may be used for the same condition as butyn ophthalmic ointment, but it is inferior to that preparation if prolonged anesthesia is desired.

CAUTION

Do not use continuously for more than three consecutive days.

EAR DROPS

Formula		Package	Average dose
C. P. Glycerin	14.0 Gm.	1 ounce dropper bottle	3 or 4 drops as needed.
Antipyrine	0.87 Gm.		
Benzocaine	0.23 Gm.		

ACTION

These ear drops owe their anesthetic properties to antipyrine and benzocaine.

CAUTION

1. Do not use for long periods of time, since ear drops tend to soften the drum membrane.
2. Do not use in an ear which is draining.

USES

1. To relieve *moderate earache* caused by inflammation and distention of the ear drum, such as occurs in infections of the middle ear, apply as directed.

2. It may be necessary to apply a hot water bottle or give aspirin or aspirin and codeine in addition to the administration of ear drops.

MINERAL OIL—OLIVE OIL

Mineral oil or olive oil, which has been heated, will relieve mild aching by the anesthetic action of heat. The oil should be heated only hot enough to be tolerated when dropped on the back of the hand.

OIL OF CLOVES
(Eugenol)

Form	Package	Average dose
Oily liquid	1 ounce	Several drops.

ACTION

Oil of cloves relieves moderate toothache, associated with tooth decay within 15 minutes and its action continues for several hours.

USES

1. To relieve *toothache,* locate the cavity, clean and dry with pledget of cotton. Plug the cavity with a pledget of cotton saturated with oil of cloves; or better, make a paste using zinc oxide powder and oil of cloves and plug the cavity with this preparation.

2. It may be necessary to give aspirin or aspirin and codeine, in addition to the local treatment.

ANTISEPTICS

MERCURY BICHLORIDE OINTMENT, OPHTHALMIC

Form	Package	Method of application
Ointment	1/8 ounce ophthalmic tube	Squeeze on lower lid as needed.

ACTION

Mercury bichloride ophthalmic ointment destroys infectious organisms, which might invade the eye, by combining with the protoplasm of the organisms. The antiseptic does not penetrate well but is effective superficially. Pus and mucus accumulations neutralize the antiseptic qualities of mercury bichloride. The ointment will be more effective when these accumulations are minimal.

USES

1. To prevent *infection* in the eye which has been scratched or in which a foreign body is imbedded, apply ointment four times daily.

2. For *bloodshot eyes associated with scanty or no drainage of pus,* apply ointment four times a day following compresses.

3. For *bloodshot eyes associated with drainage of pus,* irrigate free of pus and apply ointment four to six times a day.

SULFANILAMIDE POWDER

(See Skin Antiseptics)

ACTION AND USES

Sulfanilamide powder or sulfathiazol crystals or sulfadiazine powder is useful in the treatment of acute middle ear infections. A small amount of one of those substances is placed in the opening of the external ear canal and then blown farther into the canal. All pus that is present should be removed prior to the application of the powder. This treatment should be repeated one to three times a day depending upon the amount of drainage.

SULFATHIAZOL OINTMENT, OPHTHALMIC

Form	Package	Method of application
Ointment	1/8 ounce ophthalmic tube	Squeeze on lower lid as needed.

ACTION AND USES

Sulfathiazol ophthalmic ointment is effective in checking the growth of organisms commonly infecting the eyes. It is slightly irritating to the eye a few minutes after it has first been applied. Sulfathiazol ophthalmic ointment is used to treat the same conditions and is applied in the same manner as mercury bichloride ophthalmic ointment.

YELLOW OXIDE OF MERCURY OINTMENT, OPHTHALMIC

This has been a popular ophthalmic ointment for the treatment of styes and similar infections of the eyelids. Since it has only mild antiseptic qualities, yellow oxide of mercury ointment is not a very effective eye antiseptic. For crusted eyelids, gently rub the ointment on the eyelids night and morning.

PENICILLIN

(See Systemic Infections)

ACTION

Penicillin is the most effective agent known for the treatment of certain infections. It is not rendered ineffective to the extent that other preparations are by the presence of pus. To be fully effective, penicillin must remain in contact with the infected area for at least thirty minutes. This can be accomplished by irrigating the area and collecting the overflow with a sterile compress and using this compress as a wet dressing until the next treatment. Pus and mucus act as a mechanical barrier and should be removed before the topical application of penicillin. Penicillin solution in sealed ampuls, kept under refrigeration, will retain sufficient potency to be effective for topical applications for at least thirty days. These solutions should not be used for intramuscular injections and should be so labeled. Penicillin is usually supplied in powder form in rubber stoppered vials containing 100,000 units. This powder is dissolved by injecting 20 cc. of sterile normal saline or sterile distilled water into the vial containing the powder. The resulting solution contains 5000 units of penicillin per cc. of liquid. For some topical applications, penicillin is used in this strength. For most topical applications it will be necessary to make a solution containing 500 units per cc. This is accomplished by withdrawing 1 cc. of 5000 to 1 strength solution from the ampul and adding an additional 9 cc. of sterile normal saline or sterile distilled water in a sterilized medicine glass. Prepare only a sufficient quantity for a single treatment.

USES

1. To treat *eye infections that have failed to respond to ordinary treatment,* instill 1 to 10 cc. of penicillin solution, *500 units per cc.,* four times a day. This instillation can best be accomplished by using an eyedropper and applying the solution drop by drop. Collect excess solution on sterile gauze and allow to remain on eye as a wet compress until the next treatment.

2. To treat a *purulent eye infection associated with gonorrheal urethritis,* apply penicillin topically as above and, in addition, give 20,000 units of penicillin intramuscularly every three hours until both conditions clear up.

3. To treat *Vincent's stomatitis* (*trench mouth*), rinse mouth with 1 cc. of penicillin solution, *5000 units per cc.* Be sure that the patient rinses mouth thoroughly with the solution and that he holds it in his mouth for one half hour. The solution may be swallowed and the treatment should be repeated twice a day until the patient recovers.

4. To treat a *Vincent's ulcer of the tonsil,* apply 1 cc. of penicillin solution, *5,000 units per cc.,* to the ulcer. Gently clean the ulcer with a cotton tipped applicator until the membrane and debris have been removed. Wait until bleeding stops before applying penicillin solution. Apply the entire quantity of solution to the ulcer over a period of thirty minutes by the repeated use of 2 applicators. This is best accomplished by holding the penicillin-soaked applicator against the ulcer for one or two minutes before applying again.

MILD SILVER PROTEIN
(Argyrol)

ACTION AND USES

Mild silver protein is a mildly antiseptic, soothing liquid that is popularly used in the treatment of minor infections of the eyes, nose, and throat. It stains the secretions of the treated area and continued use over a period of months leads to argyria, a permanent, bluish discoloration of the skin.

HYDROGEN PEROXIDE

Form	Package	Average dose
Colorless liquid	1 pint bottle	Dilute with equal parts of water and apply locally.

ACTION AND USES

Hydrogen peroxide liberates oxygen upon contact with tissues. This characteristic makes it useful in the treatment of Vincent's stomatitis (trench mouth). To treat "trench mouth," use as a mouth wash or gargle every two hours. It is also of some use as a mechanical cleanser of wounds. Solutions of hydrogen peroxide are extremely unstable. This preparation is useless unless there is an active frothing (liberation of oxygen) upon contact with tissues.

SODIUM PERBORATE

Form	Package	Method of application
White powder	1 pound tin	Dissolve 1 teaspoonful of powder in 1 glass of water and use solution as mouth wash.

ACTION AND USES

Sodium perborate, dissolved in water, liberates oxygen. The available oxygen acts as an antiseptic against organisms of "trench mouth." To treat "trench mouth," use as a mouth wash or gargle every two

hours. Evidence indicates that it is slightly irritating to the membranes of the mouth if used over long periods of time. Sodium perborate has been supplanted by penicillin as the preparation of choice for treatment of "trench mouth."

NOSE DROPS

There are many commercially prepared solutions that are effective for the relief of nasal congestion. Their effectiveness is dependent upon local vasoconstriction. The persistence of this action, however, varies with the preparation, as does the amount of secondary vasodilation that follows their use. The use of nose drops should be limited to the treatment of nasal obstruction. Their indiscriminate use is discouraged because: These preparations are central nervous system and circulatory stimulants and may cause irritability, rapid pulse, palpitation, and elevated blood pressure in varying degrees. The local vasoconstriction is usually followed by a local vasodilation resulting in a greater degree of nasal obstruction than existed before the application of the nose drops. Most of these preparations are somewhat irritating to the nasal mucosa and thus, in themselves, produce a mild degree of nasal congestion.

EPHEDRINE NOSE DROPS

Form	Package	Average dose
Clear liquid	1 ounce dropper bottle	3 drops in each nostril no oftener than 5 times a day.

ACTION

The active ingredient of this preparation is ephedrine sulfate ½% in water solution. By constricting the fine blood vessels of the lining in the nose, it reduces swelling of the lining and watery discharge from the nose. Ephedrine becomes gradually less effective in relieving nasal congestion after several days use.

USES

To treat *nasal congestion* in the common cold, hay fever, and sinusitis, apply as directed.

SYSTEMIC INFECTIONS

The following drugs have been grouped together because of their action against specific micro-organisms. This is in contrast to most of the drugs discussed in this chapter which are used for the correction of a particular symptom or condition. Micro-organisms may produce

infections which remain localized or they may become temporarily uncontrolled and affect the entire body. Under these latter conditions, they are spoken of as systemic infections. Systemic infections are characterized by combinations of symptoms. Some of the symptoms are the same for all infections: elevation of temperature, increase in pulse and respiratory rates, weakness, weariness, and dulling of the senses. Other symptoms are dependent upon the location or principle site of the infection: infections of the lung are usually accompanied by increased respiratory rate, tightness in the chest, pain in the chest and cough; intestinal infections by loss of appetite, nausea, vomiting, diarrhea or constipation, and cramp-like abdominal pain. The presence of the symptoms that are general to all systemic infections is the result of a disfunction of the body as a whole in contrast to the other symptoms which arise from the disfunction of a single organ or part.

Unfortunately, there is no drug that is effective against all systemic infections. Each drug is effective against a particular kind of micro-organism or certain groups of micro-organisms. For example, quinine is effective in the treatment of malaria but ineffective in the treatment of pneumonia. Likewise, penicillin and sulfadiazine are effective in the treatment of pneumonia caused by the pneumococcus, but are completely ineffective in the treatment of pneumonia caused by a virus, and are also ineffective against the malarial organism. The scientific treatment of infectious diseases is dependent upon accurate bacteriological diagnosis. Unfortunately, the Hospital Corpsman has neither the equipment nor the knowledge that will allow him to engage in the scientific treatment of infectious diseases. His treatment of infectious diseases will thus have to depend upon broad principles of therapy and epidemiology. For example, a patient with chills and fever in an area where malaria is prevalent would ordinarily be treated with quinacrine or quinine. A patient with similar symptoms, without a history of malaria and not residing in a malarial region, should not be treated with quinacrine or quinine, but should receive sulfadiazine or penicillin, since he is more likely to have a bacterial infection. In other instances, the Hospital Corpsman will be even less able to determine in advance whether or not the infecting organisms can be controlled by the drugs at his disposal. In such cases, he should administer the most appropriate drug in the hope that it will be effective and discontinue its use should trial demonstrate it to be ineffective.

These drugs exert their beneficial effect upon systemic infections by directly inhibiting the growth of micro-organisms or by helping the body to increase its natural defenses against these micro-organisms.

Thus it is essential that all means of protecting these natural defenses be supported. These means include bed rest, proper intake of food and water and the relief of interfering symptoms through drugs, splints and other supportive measures.

In order to exert the maximum effect upon the infecting micro-organisms, these drugs must be administered in a manner that will bring an adequate concentration to the sites of infection. This is accomplished by giving the drug in such a manner that it will be absorped in an active state, by giving it in such quantities that an adequate concentration is produced, and by giving subsequent doses at frequent enough intervals to maintain the previously established concentration.

Since the use of all these drugs results in the destruction of infecting micro-organisms, their use prevents subsequent accurate bacteriological diagnosis. For this reason, considerable judgment should be exercised before using them, if it is possible to refer the patient to a physician for diagnosis and treatment within a period of eight hours. Under these conditions, the potential benefits that may accrue to the patient through their use should be carefully balanced against the potential damage that may accrue to the patient through the lack of an accurate diagnosis. Syphilis should never be treated by the Hospital Corpsman except under the supervision of a physician and after a laboratory diagnosis has been established, since in this case no harm will accrue to the patient while awaiting an accurate diagnosis. Serious potential damage may be caused by assuming a diagnosis of syphilis and starting treatment which will later have to be continued because it may never be possible to prove that this man did not have syphilis.

ANTIBACTERIAL AGENTS

PENICILLIN

Form	Package	Average dose
Yellow powder	100,000 unit rubber stoppered vial	Give 20,000 units dissolved in 4 cc. of sterile normal saline, intramuscularly, every 3 hours.

ACTION

Penicillin has a potent action on certain bacteria which cause systemic infections. The action is directly on the bacteria and holds the growth of the organisms in check while the body defenses overcome the infection. Since the organisms are not actually killed by penicillin, the treatment of systemic infections must include bed rest, adequate

amounts of food and fluids, and all other measures which will help maintain the body defenses at their greatest effectiveness. The administration of pencillin should not be discontinued until recovery from the infection seems well established.

Penicillin should be kept under refrigeration to minimize deterioration. It should not be used, except for topical application, after the expiration date stamped on the vial.

Penicillin should be given intramuscularly for the treatment of systemic infections. It is rapidly inactivated by gastric juices and absorption is poor from the rectum. Penicillin, if given by vein, is rapidly lost from the circulation unless a complicated, constant drip method is used.

No serious toxic reactions from the use of penicillin should be expected even when used in conjunction with or following the administration of other drugs.

CAUTION

Penicillin should not be used by the Hospital Corpsman to treat ulcers of the penis or any other conditions that are apt to be syphilis.

USES

Penicillin is used to prevent or treat systemic infections when the primary site of infection is as follows:

1. To prevent infection of *serious, open wounds,* such as severe injury to soft tissue, compound fractures and serious burns, give a total of 100,000 units in the prescribed manner.

2. To treat infection of *serious, open wounds,* give penicillin in the prescribed manner until symptoms subside.

3. To treat serious infections of the various *organs* of the body when fever is persistent, and when there are other signs of a progressing infection, give penicillin in the prescribed manner until these symptoms have subsided.

4. To treat *otitis media* (middle ear infection), give penicillin in the prescribed manner until symptoms have subsided.

5. To treat *rapidly spreading skin infections* with fever and a feeling of illness, give penicillin in the recommended manner together with the proper local treatment.

6. To treat *urethritis* accompanied by urethral discharge, give a total of 100,000 units in the prescribed manner. If the condition is unrelieved, discontinue the administration of penicillin and continue other measures of treatment for acute urethritis.

(See Skin and Eye, Ear, Mouth, Nose and Throat)

SULFADIAZINE

Form	Package	Average dose
7½ grains (0.5 gram) tablet	1000	Give 60 grains (4 grams) as initial dose; then 15 grains (1 gram) by mouth every 4 hours. In addition, give 1 teaspoonful of sodium bicarbonate with each dose of sulfadiazine.

ACTION

Sulfadiazine is an effective antibacterial agent against most of the micro-organisms that cause systemic infections. It is one of several sulfonamide drugs, all of which have a similar action of inhibiting the growth of certain micro-organisms. Although in the treatment of many systemic infections, the sulfonamide drugs are nearly as effective as penicillin, penicillin is usually more dependable. In a very few types of infections, sulfadiazine is effective when penicillin is not. Sulfadiazine is more convenient to give because it is given by mouth in tablet form. If the supply of penicillin is limited, sulfadiazine is generally preferred for the treatment of systemic infections of average severity, thus reserving penicillin for the treatment of more severe infections.

CAUTION

1. Sulfadiazine should not be used for the treatment of infections so mild that the patient need not go to bed. The exception to this rule is gonorrhea. Difficulties may be avoided by adhering to this rule.

2. All sulfonamide drugs may be toxic to certain individuals and symptoms of such toxicity should be anticipated.

USES

1. To prevent and treat the *severe infections* listed under penicillin. give sulfadiazine in accordance with the dosage schedule listed under average dose. Treatment should be continued until all danger of infection or recovery from the infection seems well established. The drug should be discontinued after a trial of three days has proven it to be ineffective.

2. To treat *infected inguinal lymph glands*, whether or not they are associated with a penile ulcer, give sulfadiazine according to the average dose schedule until recovery seems well established or until the drug has been proven ineffective.

3. To treat *gonorrheal urethritis*, use sulfadiazine grains 15 (1 gram), four times a day. This treatment should be continued for five days and

then stopped regardless of its effect on the urethral discharge. If penicillin has not already been administered, give this drug as directed should sulfadiazine prove ineffective.

4. To treat *persistent diarrhea associated with fever*, give sulfadiazine grains 15 (1 gram), four times a day and continue for one day after symptoms have subsided.

5. To treat *milder systemic infections* in which the likelihood of sulfadiazine being of value is doubtful, give sulfadiazine grains 15 (1 gram), four times a day. The drug should be discontinued after a trial of three days has proven it to be ineffective.

TOXICOLOGY

A few individuals are sensitive to sulfonamide drugs, and many more may develop a sensitivity during the administration of sulfonamide drugs over a continued period of time. This sensitivity to the drug is usually expressed, in the early stages, by mild reactions such as chilly sensations, fever, vomiting, headache, and local or general skin eruption. If the drug is not discontinued, severe damage to the patient may result. An unexpected rise in temperature, particularly one not associated with a rise in pulse rate, is an important signal of a more serious toxic reaction. Sulfadiazine is particularly prone to cause serious kidney damage. This tendency can be partially overcome by the concurrent administration of sodium bicarbonate.

Should a toxic reaction occur, stop the administration of the drug and give patient a minimum of 4 quarts (4,000 cc.) of fluids every twenty-four hours.

ANTIMALARIAL AGENTS

The drugs that are used for the treatment of malaria are effective in overcoming an attack of this disease and may be used to prevent attacks of malaria. The exact manner in which these drugs exert their action is not completely understood; however, it is known that following their administration in adequate amounts, the malarial parasites cannot be demonstrated in the blood stream. The cure of malaria is dependent upon the development of immunity and the development of this immunity can only be aided by the administration of antimalarial drugs.

The antimalarial drugs are given in established cases of malaria with the intention of terminating as quickly as possible the symptoms of the disease. Experience has shown that recurrence of the symptoms, following the cessation of treatment, is common with certain types of malaria. These recurrences of symptoms are expressions of the failure

of the body to develop an immunity and are not indicative of ineffectiveness of the drug.

The antimalarial drugs may also be used as a prophylaxis for malaria. Their action is one of preventing the development of symptoms of the disease and not of preventing infection with the disease. Because of this action, the administration of the antimalarial drugs for the above purpose is usually spoken of as suppressive treatment and not prophylaxis, since individuals receiving antimalarial drugs may actually be infected with the malarial organisms. Because the malarial organisms may still be present, the clinical symptoms of the disease may develop should administration of the drug be stopped. In other instances, the clinical symptoms of malaria may develop despite the administration of what is usually an adequate dose to suppress these symptoms. Since the likelihood of the development of malarial symptoms is fairly great, once the administration of the drug is stopped, it is generally recommended that suppressive treatment be continued until such a time that the development of symptoms will not create a serious hardship. Many of these individuals will not develop the symptoms of malaria following the discontinuance of suppressive treatment due to their failure to become infected or due to their development of immunity during the period of treatment.

These drugs are toxic to the body in large doses and for this reason, the dosage schedule must be strictly followed.

QUININE SULFATE

Form	Package	Average dose
5 grains (0.3 gram) white tablet or capsule	1000	See schedule below.

ACTION

Quinine sulfate is an extract of the bark of the cinchona tree. It is effective to prevent and treat the symptoms of malaria. In addition to this action, it has other effects on the body, some of which are unpleasant and others undesirable. These side effects are particularly noticeable following the administration of excessive doses.

Totaquine is a mixture of quinine and other active principles of the cinchona bark. It may be used as a substitute for quinine sulfate.

CAUTION

Do not use quinine to treat conditions other than malaria.

QUINACRINE
(Atabrine)

Form	Package	Average dose
1½ grains (0.1 gram) yellow tablet	1000	See schedule below.

ACTION

Quinacrine is a synthetic preparation similar to quinine sulfate in chemical composition and in its action against malaria. The use of this drug, which is a dye, often results in a temporary, yellow discoloration of the skin. This effect is observed in approximately half of the people receiving it provided the administration is continued over a period of several weeks. This discoloration of the skin is harmless and will disappear several weeks after the drug has been discontinued. The administration of atabrine in quantities in excess of that recommended, frequently leads to toxic symptoms. Mild degrees of nausea, vomiting, and diarrhea sometimes occur following the recommended doses, particularly when the co-administration of sodium bicarbonate has been omitted. These symptoms will usually disappear if treatment is continued and usually are not severe enough to justify the discontinuance of treatment. In these situations it may be advisable to divide the daily dose into smaller units and give them at more frequent intervals.

SUPPRESSIVE TREATMENT OF MALARIA

Preferred Method

Give quinacrine, grains 1½, six days a week. Start ten days before entering malarial zone. If it is necessary to prevent the danger of clinical malaria developing aboard ship after departure from a malarial zone, it will be necessary to continue quinacrine as above until ten days prior to the departure of the man from the ship. Give ¼ teaspoonful of sodium bicarbonate with each dose of quinacrine.

Alternate Method

Give quinine sulfate, grains 10, daily, upon entering a malarial zone and continue treatment as directed for quinacrine.

TREATMENT OF MALARIAL ATTACK

Preferred Method

Give quinacrine, grains 3, for five doses during the first twenty-four hours; then give quinacrine, grains 1½, three times a day for an addi-

tional six days. Give 1/4 teaspoonful of sodium bicarbonate with each dose of quinacrine. If symptoms recur after a period of rest from treatment, repeat the treatment.

Alternate Method

Give quinine sulfate, grains 15, three times a day for two days; then grains 10, three times a day for an additional five days.

The use of this alternate method is indicated (1) if quinacrine is unavailable, or (2) if the patient develops a toxic reaction to quinacrine, or (3) if the patient presents a history of toxic reaction to quinacrine.

ANTISYPHILITIC AGENTS

There are several drugs which are specific against the micro-organism causing syphilis. None of these drugs should be administered by the Hospital Corpsmen unless they are given under the immediate supervision of a physician. There may, however, be instances where it will be desirable to continue antisyphilitic treatment at sea with bismuth subsalicylate, following establishment of a definite diagnosis and following the administration of considerable treatment ashore. Even in such instances, the administration of bismuth subsalicylate will be performed only under the express direction and in the express manner outlined by a physician. These safeguards are necessitated by the nature of the disease. Syphilis has social as well as medical implications and its mismanagement, particularly in the early stages, is apt to lead to serious complications and confusion.

BISMUTH SUBSALICYLATE

Form	Package	Average dose
Suspension of white powder in oil	2 cc. ampul or 30 cc. vial	Give 3 grains (0.2 gram) intramuscularly. This quantity is usually contained in 2 cc. of the preparation. This dose is usually repeated at weekly intervals.

ACTION AND USES

Bismuth subsalicylate is commonly used in the treatment of syphilis in conjunction with arsenical drugs and penicillin. It is apparently effective against syphilis by aiding the body to develop a resistance against the disease rather than by exerting any direct killing effect on the causative micro-organism. Unless bismuth subsalicylate is used in conjunction with other drugs, it is not a satisfactory treatment for syphilis. It is relatively non-toxic and its ease of administration makes it a useful drug for administration at sea between more intensive

periods of treatment ashore. Bismuth subsalicylate should be used only upon the direction and in a manner prescribed by a physician.

MISCELLANEOUS PREPARATIONS

ANTITOXINS

Antitoxins are so called because they neutralize toxins. The Hospital Corpsman should be familiar with three common antitoxins, namely: diphtheria antitoxin, gas gangrene antitoxin, and tetanus antitoxin. The bacteria that cause diphtheria, gas gangrene, and tetanus produce the ill effects of these diseases by poisoning the body with toxins which are manufactured during the growth process of these bacteria. These toxins produce their symptoms following a combination with the tissues of the body, and after this union, can never be neutralized. Antitoxin exerts its protecting influence by combining with the toxins that are not united with body tissues. Once a toxin-antitoxin union has been established, the toxin can no longer exert a harmful influence.

The human, like all animals, is capable of and does produce antitoxins when stimulated to do so by the presence of toxins. Each antitoxin that is produced is specific for the particular toxin that stimulated its production. In the presence of an infection by one of these microorganisms, the body is usually unable to produce an adequate amount of antitoxin to cope with the situation and additional antitoxin is necessary to prevent serious effects. Commercial antitoxin is produced by injecting toxin in increasing quantities into horses or certain other animals until the serum of the animal contains large quantities of antitoxin per unit of serum. The animal is bled and the antitoxin-laden serum is purified, standardized and packaged.

While this preparation has been considerably purified, it still contains elements of horse serum which produce undesirable reactions (allergy) in some individuals. Certain of these reactions need cause the Hospital Corpsman no concern. Others are extremely dangerous and for this reason, it is necessary to test for sensitivity prior to the use of any antitoxin. The most satisfactory test for the Hospital Corpsman is the conjunctival test which is done by dropping one drop of a 1 to 10 dilution (1 drop of serum to 9 drops of water) into the conjunctival sac of the patient's eye. A positive reaction is characterized by the appearance within five minutes of itching, redness and swelling of the conjunctiva and eyelids. If this reaction is marked, it may be relieved by the instillation of 1 or 2 drops of 1 to 1000 adrenalin solution in the eye. Patients showing a negative reaction may be given full doses

of antitoxin without fear of dangerous reactions. If the patient shows a positive reaction to the test, the antitoxin must be administered in the following manner: Give the antitoxin subcutaneously at twenty minute intervals, starting with a dose of 0.1 cc. of a 1 to 10 dilution. Double each subsequent dose until the entire quantity has been given. It will be necessary to prepare at least 15 cc. of a 1 to 10 dilution in order to give the antitoxin in the above method. In making this diluted solution, all solutions and equipment must be sterile.

SUGGESTED DOSAGE SCHEDULE

1st dose	0.1 cc.	(1 to 10 dilution)
2d dose	0.2 cc.	(1 to 10 dilution)
3d dose	0.4 cc.	(1 to 10 dilution)
4th dose	0.8 cc.	(1 to 10 dilution)
5th dose	1.5 cc.	(1 to 10 dilution)
6th dose	3.0 cc.	(1 to 10 dilution)
7th dose	6.0 cc.	(1 to 10 dilution)
8th dose	1.0 cc.	Undiluted
9th dose	2.0 cc.	Undiluted
10th dose	4.0 cc.	Undiluted

In order to prevent diseases caused by toxins, a much smaller quantity of antitoxin is required than is necessary for the treatment of the disease. Antitoxin is given prophylactically to supply the body with an adequate amount of immediately available antitoxin so that all toxins produced by bacterial growth may immediately be neutralized. In this way, the body is given sufficient time to develop its own defenses. The use of antitoxins in the treatment of already existing infection is dependent upon giving a sufficiently large quantity in order to neutralize all of the toxin that has not as yet united with the body tissues. Subsequent doses are very much smaller since they are designed to neutralize toxin that has been produced since the initial dose of antitoxin.

DIPHTHERIA ANTITOXIN

Form	Package	Average dose
40,000 units	Syringe	Mild Cases: 20,000 to 40,000 units, intramuscularly. Severe Cases: 80,000 to 120,000 units, intramuscularly.

ACTION AND USES

Diphtheria antitoxin is a specific agent for the neutralization of the toxin produced by the micro-organism causing diphtheria. Under ordi-

nary circumstances, this drug should be given only under the direction of a physician.

TETANUS ANTITOXIN

Form	Package	Average dose
1,500 units	Syringe	Prophylactic dose: 1,500 units, subcutaneously.

TETANUS, GAS-GANGRENE ANTITOXIN

Form	Package	Average dose
Tetanus antitoxin, 1,500 units	Syringe	Prophylactic dose: Contents of 1 syringe, intramuscularly.
Perfringens antitoxin 2,000 units		
Vibrion septique antitoxin 2,000 units		

ACTION AND USES

The Hospital Corpsman will rarely require tetanus and gas-gangrene antitoxins for other than prophylactic purposes. Even though the danger of a wound becoming infected with the micro-organisms causing tetanus and gas-gangrene is greatly lessened by the occurrence of the wound aboard ship, every wound which is associated with fairly extensive destruction of tissue, and deep embedding of foreign particles as well as puncture wounds carrying foreign particles deep into the tissues, should receive the added protection afforded by tetanus prophylaxis. Since these antitoxins contain horse serum, they carry with them the risk of allergic reactions. A better protection against tetanus is obtained by immunizing the individual in advance of the injury. This is accomplished through the use of tetanus toxoid.

COMPRESSES, GARGLES, IRRIGANTS, PACKS, AND SOAKS

ALKALINE AROMATIC TABLETS

Form	Package	Method of application
Large, aromatic tablet	100	See Uses.

BORIC ACID CRYSTALS

Form	Package	Method of application
White crystals	1 pound	See Uses.

DOBELL'S TABLETS

Form	Package	Method of application
Large tablet	100	See Uses.

MAGNESIUM SULFATE

(See Laxatives.)

SODIUM BICARBONATE

(See Antacids.)

SODIUM CHLORIDE

(Table Salt or Salt Tablets.)

ACTION

These preparations are ordinarily used as hot solutions. In this form they are used to remove exudates, to soothe irritated surfaces, and to increase circulation. Some are slightly antiseptic and others are mildly astringent or mildly anesthetic, but these actions are not remarkable. Probably the greatest benefit is derived from the heat of the solution. For this reason, care should be exercised to keep these solutions warm during their application. When using compresses, packs and soaks, the heat may be maintained by frequent additions of extra solution that is kept hot for this purpose. The temperature of any solution should not be greater than can be easily tolerated.

With the exception of solutions that are to be used to clean or irrigate uninfected wounds, these solutions need not be sterilized. They should be prepared by dissolving the drug in boiling water. All utensils used in their preparation and storage should be scrupulously cleaned and preferably boiled before use. Tablet preparations should be crushed before attempting to dissolve them. In order to prepare percentage strength solutions for these purposes, dissolve one level teaspoonful of the drug per pint of water for each percent desired.

USES

Drugs	Irrigants	Gargles	Compresses	Packs	Soaks
Alkaline Aromatic Tablets	Throat irrigation only. 8 tablets to 1 quart of water.	2 tablets to ½ glass of water.			
Boric Acid Powder	4%		4%	4%	4%.
Dobell's Tablets	Throat irrigation only. 8 tablets to 1 quart of water.	2 tablets to ½ glass of water.			
Magnesium Sulfate Crystals			20%	20%	20%.
Sodium Bicarbonate	4%	4%			
Sodium Chloride	1%	1%	1%	1%	1%.

DISINFECTANTS

ALCOHOL

(See Skin Antiseptics.)

COMPOUND CRESOL SOLUTION
(Lysol)

Form	Package	Method of application
Thick, brown liquid	1 pint	See Uses.

CHLORINATED LIME
(Chloride of Lime)

Form	Package	Method of application
White powder with chlorine odor	12 ounce container	See Uses.

ACTION

Disinfectants are used to sterilize contaminated materials to prevent the spread of pathogenic micro-organisms. This is called chemical sterilization. To be effective, the disinfectant must be used in sufficient concentration and must remain in contact with the contaminated material for a sufficient period of time. The materials to be sterilized may be either instruments, which are contaminated with common infectious micro-organisms and must be sterile before using, or articles or excreta which are contaminated with micro-organisms from patients with contagious diseases.

USES

1. To disinfect *cleaned articles* such as glassware, metal and enamelware utensils, instruments, non-boilable suture material, boilable suture material in ampuls, rubber goods, needles, and sharp-edged instruments: (Boiling is the preferred method of disinfection for this equipment with the exception of non-boilable sutures and sharp-edged instruments.)

Drug	Percentage solution	Contact period
Compound Cresol Solution	2.5%	20 minutes.
Alcohol	70%	20 minutes.
Accepted commercially prepared antiseptics	Varies with the solution	20 minutes, but may vary with the solution.

2. To disinfect *uncleaned articles* such as eating utensils, glassware, metal and enamelware utensils, instruments, rubber goods, and thermometers used by patients with contagious diseases:

Drug	Percentage solution	Contact period
Compound Cresol Solution	2.5%	30 minutes.
Alcohol	70%	30 minutes.
Accepted commercially prepared antiseptics	Varies with the solution	30 minutes, but may vary with the solution.

3. To disinfect *cleaned thermometers* used by patients without contagious diseases:

Drug	Percentage solution	Contact period
Alcohol	70%	3 minutes.
Compound Cresol Solution	2.5%	3 minutes.
Accepted commercially prepared antiseptics	Varies with the solution	3 minutes, but may vary with the solution.

4. To disinfect the *hands,* contaminated while caring for a patient with a contagious disease, wash thoroughly with soap and water and immerse in a 1% compound cresol solution.

5. To disinfect *bed* and *table linens* and *blankets* used by patients with contagious diseases, soak for thirty minutes in 2.5% compound cresol solution.

6. To perform terminal disinfection of *pillows, mattresses, room furnishings* and *rubber sheets,* used by patients with contagious diseases, wipe the articles with 2.5% compound cresol solution. Then air for twenty-four hours.

7. To disinfect *food scraps, urine, feces,* and other *body excreta* before disposal, mix thoroughly and allow to remain in contact with an equal quantity of:

Drug	Percentage strength	Contact period
Chlorinated Lime	Saturated solution	2 hours.
Compound Cresol Solution	2.5%	2 hours.

VACCINES

A vaccine may be defined as any substance used for preventive inoculation. These substances usually contain bacteria, viruses, or bacterial toxins which have been altered in such a manner that their inoculation does not produce the disease, but does stimulate the development in the recipient of immunity against the micro-organism or toxin. For the convenience of administration these active principles are suspended in salt solution, or in the case of smallpox vaccine, in glycerin. They are usually administered into or under the skin, and their administration may be associated with mild local and mild systemic reactions. The immunity produced by vaccines varies in degree and length of time. Certain vaccinations must be repeated as often as every four months, while others afford protection for more than five years. In some instances, the entire series of inoculations must be repeated and, in others, small stimulating doses ("booster" doses) given at specified intervals will maintain a high degree of protection. Because the systemic effects of these vaccines may be somewhat dangerous to elderly and sick individuals, they are ordinarily not given to these persons unless there is immediate danger of the disease, such as would exist in the presence of an epidemic.

Immunization is performed with two main objectives in view: (1) to protect the individual against disease (2) to protect the community against epidemics by eliminating large numbers of non-immune individuals from the population. In all instances it is the individual who gains by elimination of disease, either through individual protection, or by the elimination of epidemics.

It is obvious that protection against a disease by vaccination is necessary only when there is danger of acquiring the disease. Certain diseases have a universal distribution and present an ever-present danger. Examples of these are smallpox, typhoid fever, and tetanus. There are other diseases which are potentially dangerous to the individual only when he is present in areas where they prevail. Examples of these are yellow fever, typhus fever and cholera.

CHOLERA VACCINE

Form	Package	Dose
Yellow fluid	Rubber stoppered vial	0.5 cc. or 1.0 cc. subcutaneously.

NOTE: The dosages of vaccines recommended in this section pertain to the vaccines in current use. With the development of new and better preparations, dosage schedules may be altered. The Hospital Corpsman is advised to refer to the specific directions accompanying the vaccine.

ACTION AND USES

Cholera vaccine provides a partial, transitory protection against cholera. This vaccine should be given to all persons who enter areas where cholera is present or in the event of a threat of, or the presence of, an epidemic of this disease.

To immunize with this vaccine, give an initial dose of 0.5 cc. by subcutaneous injection and follow by a second dose of 1.0 cc. after an interval of seven to ten days. In order to provide continued protection to the vaccinated person, give a "booster" dose of 1.0 cc. every six months.

REACTIONS

The administration of cholera vaccine may be followed by mild redness and tenderness at the site of inoculation. At times, a systemic reaction consisting of mild body weariness and slight elevation of temperature may result. These symptoms may be prevented and treated with aspirin in customary dosage.

CAUTION

Keep vaccine under refrigeration and shake well before using.

SMALLPOX VACCINE

Form	Package	Dose
Milky fluid	Capillary tube	Contents of 1 tube, intradermally.

ACTION AND USES

Smallpox vaccine is one of the most successful of all vaccines. Any case of smallpox that develops is definitely the result of neglect. This vaccine is a living virus and following its introduction into the body, produces a mild systemic infection (vaccinia). This disease results in the development of an immunity, not only against itself, but also more importantly, in the development of the desired immunity against smallpox.

All persons should be vaccinated against smallpox in the first few months of their life. This vaccination should be repeated every five to seven years thereafter. Additional vaccination should be performed in the threat of, or in the presence of, an epidemic of smallpox. Repeated vaccinations need not be feared since systemic reactions only occur in those individuals who do not have immunity and therefore need the vaccination.

REACTIONS

The local reactions to smallpox vaccine are of two types:

Immune Reaction: A mild itching and redness at the site of inocula-

tion which reaches its maximum intensity in eight to seventy-two hours after vaccination and subsides quickly. This is the characteristic response of the skin of the individual possessing an immunity to smallpox. There are no systemic symptoms associated with this reaction.

"*Take*": Slight redness and itching, beginning about the third or fourth day which develops into a small, red, raised spot (papule) which quickly develops into a pus-filled elevation (pustule) and later becomes a thick crust. The rapidity with which these changes occur and the degree of their severity is a reflection of the amount of immunity present in the vaccinated person, the more rapid and more mild the process, the higher the degree of immunity. The more severe local reactions are usually associated with mild, systemic symptoms.

The Hospital Corpsman should examine the site of vaccination at forty-eight hour intervals to determine the type of reaction. Vaccination should be considered as unsuccessful if no reaction occurs and should be repeated.

CAUTION

Store vaccine in freezing compartment of refrigerator.

TETANUS TOXOID
(Alum Precipitated)

Form	Package	Dose
White, milky liquid	Rubber stoppered vial	0.5 cc. intramuscularly.

ACTION AND USES

Alum precipitated tetanus toxoid consists of tetanus toxin which has been so altered that it no longer will produce the symptoms of tetanus, but will stimulate the development of tetanus antitoxin. The tetanus toxoid is precipitated with alum in order that it will be more slowly absorbed and thus exert its effect over a longer period of time, and in this way produce a higher degree of immunity. The above action is in direct contrast to the temporary immunity conferred by the administration of tetanus antitoxin. Tetanus toxoid does not contain animal serum and there is no risk of allergic reactions following its administration.

Tetanus toxoid should be administered to all persons engaged in activities in which puncture wounds, bullet wounds, deep lacerations, compound fractures, and deep wounds associated with the imbedding of foreign bodies are likely to occur. Give 0.5 cc. of alum precipitated tetanus toxoid by intramuscular injection and repeat this injection in four to six weeks. A "booster dose" of 0.5 cc. should be given one year

after the initial series, repeated at five year intervals, and immediately given following any of the aforementioned injuries.

REACTIONS

Intramuscular injections of tetanus toxoid do not produce systemic reactions, but there may be temporary tenderness and soreness at the site of injection. These local reactions, while common, are usually the result of imperfect administration.

CAUTION

Keep vaccine under refrigeration and shake well before using.

TYPHOID VACCINE

Form	Package	Dose
Opalescent liquid	Rubber stoppered bottle	0.5 cc. or 1.0 cc. subcutaneously.

ACTION AND USES

Typhoid vaccine consists of a suspension of killed typhoid micro-organisms in normal saline. Most preparations, in addition, contain the killed micro-organisms of paratyphoid A and paratyphoid B. Vaccination with this preparation produces a temporary immunity against typhoid fever.

To immunize a person with typhoid vaccine, give 0.5 cc. subcutaneously and follow with two 1.0 cc. doses at seven day intervals. Then give a "booster" dose of 0.5 cc. subcutaneously at yearly intervals to maintain continued immunity. Typhoid vaccine should be given to all persons who are apt to be exposed to contaminated food or water. This usually includes persons traveling away from home as well as those who are living in areas where purity of food and water is questionable.

REACTIONS

Mild redness and tenderness sometimes occur at the site of inoculations. If the vaccine is given too deeply (intramuscularly), marked muscular soreness occurs. Mild systemic reactions, consisting of fever, headache, and general body weariness, sometimes follow one of the inoculations in a series. These symptoms may be prevented or alleviated by the administration of aspirin in customary dosage.

CAUTION

Store typhoid vaccine in the refrigerator and shake well before using.

TYPHUS VACCINE

Form	Package	Dose
Pale, yellow liquid	Rubber stoppered bottle	1.0 cc. subcutaneously.

ACTION AND USES

Typhus vaccine produces a temporary immunity against typhus fever. To immunize against typhus fever, give a series of three 1.0 cc. subcutaneous injections at seven to ten day intervals. A "booster" dose of 1.0 cc. every six months should be given while danger of typhus fever exists. Immunization against typhus fever is advised for all persons entering areas where this disease is present.

REACTIONS

Each injection of typhus vaccine is followed immediately by a sharp stinging sensation caused by the preservative in the vaccine. Systemic reactions are very unlikely.

CAUTION

Store typhus vaccine under refrigeration.

YELLOW FEVER VACCINE

Form	Package	Dose
Yellow powder	Sealed ampul	Single, subcutaneous injection.

ACTION AND USES

Yellow fever vaccine contains a live virus. A single subcutaneous injection of this virus results in an immunity to yellow fever which persists for four or more years. To immunize a person against yellow fever, give a single, subcutaneous injection of the vaccine. Each ampul of vaccine contains a specified number of doses and the size of the individual dose depends upon the quantity of normal saline that is used to dissolve the powdered vaccine. Individuals traveling in yellow fever areas should be immunized.

REACTIONS

Very mild and extremely transitory symptoms, such as lassitude, may follow the administration of this vaccine. The jaundice-producing quality of former yellow fever vaccines has been eliminated.

CAUTION

Keep vaccine frozen and use within sixty minutes after thawing and diluting. The unused portion of any diluted vaccine should be discarded.

VENEREAL DISEASE PROPHYLAXIS

The following preparations are those usually found in venereal disease prophylactic kits. The thorough cleansing with soap and water that precedes the use of these preparations is equally as important as the use of the preparations themselves. Each preparation is intended to provide protection against a specific venereal disease, although there is a degree of cross-protection.

MILD MERCUROUS CHLORIDE OINTMENT
(Calomel Ointment)

Form	Package	Method of application
White ointment	Yellow tube of V.D. prophylactic kit	Apply ointment to the genitalia and the skin of the surrounding area.

ACTION AND USES

Calomel ointment is a specific antiseptic for the prevention of syphilis. It is effective when applied according to standard prophylactic technique. This may be the only preparation found in many prophylactic kits. In combination with thorough washing, it exerts a mild degree of protection against gonorrhea. Calomel ointment is at times combined with sulfathiazol ointment and other substances for use in single-tube prophylactic kits.

STRONG SILVER PROTEIN
(Protargol)

Form	Package	Method of application
Brown liquid	Red tube of V.D. prophylactic kit	Inject contents into urethral opening and retain for five minutes.

ACTION AND USES

Strong silver protein 2% is a specific antiseptic for the prevention of gonorrhea. It is effective when applied according to standard prophylactic technique.

VITAMINS

VITAMIN B_1
(Thiamin Chloride)

Form	Package	Average dose
Tablet and liquid	100 tablets or rubber stoppered vial	Daily requirement: 1 to 2 milligrams. Therapeutic dose: 10 to 100 milligrams daily.

ACTION AND USES

Thiamin chloride is essential for good health. It is usually obtained in adequate quantities in the normal diet. The Hospital Corpsman will find very little use for this preparation and, in general, he should use it only when advised to do so by a physician.

VITAMIN C
(Ascorbic Acid)

Form	Package	Average dose
Tablet	100	Daily requirement: 25 milligrams. Therapeutic dose: 50 to 200 milligrams daily.

ACTION AND USES

Ascorbic acid is necessary for the preservation of health. Its absence results in scurvy, which was early known to be an occupational disease of seamen. This vitamin is found in citrus fruits, and to a lesser extent in other fruits and vegetables. Under ordinary conditions, a normal diet contains the required amount of this vitamin. The Hospital Corpsman will have very little use for this preparation, and, in general, should use it only upon the advice of a physician.

POISONS; SYMPTOMS AND TREATMENT

Poison	Symptoms	Treatment
ACIDS:		
Acetic, Glacial Hydrochloric Nitric Sulfuric	External: Burn with hard coagulum	1. Wash with running water 2. Apply sodium bicarbonate paste 3. Treat as a burn
	Internal: 1. Pain in mouth, throat, and abdomen 2. Stains on lips and mouth 3. Nausea, vomiting, and diarrhea. Vomitus may contain blood and mucous shreds 4. Profound shock with clammy skin, cyanosed face, dilated pupils, weak rapid pulse, labored breathing, and subnormal temperature	1. Do not use stomach tube or induce vomiting 2. Give milk of magnesia, lime water, or soapy water 3. Give demulcents such as egg white, olive oil, milk of bismuth 4. Give morphine for severe pain 5. Treat for shock and collapse

POISONS; SYMPTOMS AND TREATMENT—Continued

Poison	Symptoms	Treatment
ALCOHOL: Ethyl Methyl CHLOROFORM: ETHER: PARALDEHYDE:	1. Characteristic odor to breath 2. Depression of central nervous system, muscular incoordination, stupor 3. Pupils normal or dilated 4. Respiration slow and noisy 5. Skin cold and clammy, subnormal temperature 6. Heart rate fast	1. Give emetic or use gastric lavage 2. Give strong hot coffee, if conscious, and exercise patient 3. Give caffeine sodium benzoate, 7½ gr. ampul or ephedrine sulfate, ¾ gr. ampul, if stuporous 4. Preserve body warmth
ALKALIS: Lye Caustic Soda Ammonia Lime	External: Burns with soft coagulum Internal: 1. Pain in mouth, throat, and abdomen 2. Stains on lips and mouth 3. Nausea, vomiting, diarrhea. Vomitus may contain blood and mucous shreds 4. Varying degrees of shock may be produced	1. Wash with running water 2. Apply weak acid such as vinegar 3. Treat as a burn 1. Do not use stomach tube or induce vomiting 2. Give large amounts of weak acid such as vinegar, lemon juice, or grapefruit juice 3. Give large amounts of egg white or milk 4. Give morphine for severe pain 5. Treat for shock and collapse
AMYL NITRITE:	See Nitrites	See Nitrites
ARSENIC: Paris Green "Rough on Rats" Fowler's Solution	Symptoms rarely develop until 30 minutes to several hours after ingestion 1. Intense upper abdominal pain 2. Vomiting and diarrhea ("rice water" and blood streaked) 3. Exhaustion, followed by collapse	1. Induce vomiting or give gastric lavage with warm water 2. Give half glass of milk of magnesia 3. Give saline cathartic 4. Treat for shock and collapse

POISONS; SYMPTOMS AND TREATMENT—Continued

Poison	Symptoms	Treatment
ATROPINE: (Belladonna) SCOPOLAMINE:	1. Dryness and burning of mouth and throat. Swallowing may be impossible 2. Marked thirst 3. Flushed skin 4. Fever and rapid pulse 5. Wide dilation of pupils. Vision blurred 6. Mental excitement, confusion, and delirium (may be mistaken for intoxication with alcohol, or insanity) 7. Collapse and coma	1. Induce vomiting or give gastric lavage 2. Give large quantities of strong tea (for tannic acid content) 3. Control mental confusion and delirium by physical restraint and give average doses of sodium pentobarbital or paraldehyde and repeat as needed 4. If comatose, give central nervous system stimulants 5. Artificial respiration may be necessary
BARBITURATES: CHLORAL HYDRATE: ("Knock-out Drops")	1. Progressive central nervous system depression, deep sleep, coma 2. Respiratory depression, cyanosis 3. Subnormal temperature 4. Low blood pressure	1. Give gastric lavage 2. Give one ounce of concentrated magnesium sulfate solution by stomach tube 3. Give central nervous system stimulants and artificial respiration, if necessary 4. Preserve body heat 5. Change patient's position frequently
BELLADONNA:	See Atropine	See Atropine
BENZENE:	Same as alcohol poisoning	Same as alcohol poisoning
BENZINE:	Same as alcohol poisoning	Same as alcohol poisoning
BROMIDES:	1. Mental confusion, muscular incoordination, irritability, insomnia 2. Coma 3. Skin rashes are common	1. Give sodium chloride, ½ teaspoonful in water, every two hours 2. Give at least 4,000 cc. of fluids daily 3. Give central nervous system stimulants, if necessary

POISONS; SYMPTOMS AND TREATMENT—Continued

Poison	Symptoms	Treatment
CANNABIS (hashish, marijuana):	1. Emotion disturbances, excitement, delirium, and mania may ensue 2. Large doses eventually produce sleep	1. Induce vomiting or give gastric lavage 2. Give strong tea solution 3. Restrain patient if necessary
CARBON MONOXIDE:	1. Frontal headache, dizziness, ringing in ears, nausea, muscular weakness 2. Pink skin 3. Unconsciousness and collapse	1. Carry patient out of enclosed room to the fresh air 2. Give artificial respiration, if necessary
CARBON TETRACHLORIDE:	Same as alcohol poisoning	Same as alcohol poisoning
CHLORAL HYDRATE:	See Barbiturates	See Barbiturates
CHLOROFORM:	See Alcohol	See Alcohol
CODEINE:	See Morphine	See Morphine
CRESOL SOLUTION, COMPOUND:	External: White stain on skin Internal: 1. White stains on lips and mouth later becoming red-brown 2. Vomiting 3. Collapse and shock 4. Decreased urine output, dark urine	 1. Rinse with alcohol 2. Treat as a burn 1. Give gastric lavage with large quantities of olive or other vegetable oil. Leave 100 cc. of clean oil in stomach after lavage 2. Give glucose and normal saline intravenously 3. Treat for shock and collapse
CYANIDES: Hydrocyanic Acid Prussic Acid Fumigating Gas	1. Dizziness, headache, staggering gait, insensibility 2. Panting respiration	1. Remove to fresh air and give artificial respiration, if necessary
ETHER:	See Alcohol	See Alcohol
FORMALDEHYDE:	1. Irritation of eyes and respiratory tract with pain, vomiting, and diarrhea 2. Vertigo, depression, coma	1. Induce vomiting or give gastric lavage 2. Treat for shock and collapse and give artificial respiration, if necessary

POISONS; SYMPTOMS AND TREATMENT—Continued

Poison	Symptoms	Treatment
GASOLINE:	Same as alcohol poisoning	Same as alcohol poisoning
IODINE:	1. Lips and mouth burned and stained 2. Burning pain, nausea, vomiting 3. Collapse 4. Suppression of urine	1. Give large quantities of starch solution and repeat several times 2. Treat for shock and collapse
KEROSENE:	Same as alcohol poisoning	Same as alcohol poisoning
LYSOL:	Same as compound cresol solution poisoning	Same as compound cresol solution poisoning
MARIJUANA:	See Cannabis	See Cannabis
MERCURY BICHLORIDE:	1. Abdominal pain, vomiting, diarrhea (may be bloody) 2. Collapse 3. Swelling and necrosis of oral mucous membrane 4. Suppression of urine 5. Severe kidney damage	1. Induce vomiting or give gastric lavage 2. Give egg whites in milk or give soapy water 3. Repeat gastric lavage and instill one ounce of magnesium sulfate in stomach 4. Treat for shock and collapse, and give morphine for pain
MORPHINE: Opium Codeine	1. Progressive central nervous system depression, inattention, lethargy, stupor, coma 2. Depressed respiration 3. Pinpoint pupils 4. Slow, feeble, irregular pulse	1. Give gastric lavage of 1-1000 solution of potassium permanganate 2. Attempt to keep patient awake 3. Give central nervous system stimulants and artificial respiration, if necessary
NITRITES: Amyl Nitrite Nitroglycerin	1. Weakness, dizziness, headache, nausea, vomiting, restlessness, pallor, sweating, and collapse 2. Rapid respiration and pulse rates	1. Give gastric lavage 2. Treat for shock and collapse
OPIUM:	See Morphine	See Morphine
PARALDEHYDE:	See Alcohol	See Alcohol

POISONS; SYMPTOMS AND TREATMENT—*Continued*

Poison	Symptoms	Treatment
PENTOBARBITAL SODIUM:	See Barbiturates	See Barbiturates
PHENOBARBITAL:	See Barbiturates	See Barbiturates
PHENOL (Carbolic Acid):	Same as compound cresol solution poisoning	Same as compound cresol solution poisoning
SCOPOLAMINE:	See Atropine	See Atropine
SILVER NITRATE:	1. Brown stains on mouth which become black 2. Vomiting and abdominal pain 3. Collapse and shock	1. Give large quantities of table salt solution by mouth, or gastric lavage 2. Treat for shock and collapse
STRYCHNINE:	1. Stiffness and twitching of muscles, followed by convulsions 2. Severe pain with convulsions; patient remains conscious	1. Before convulsions appear, induce vomiting or give gastric lavage with 1-1000 potassium permanganate solution. Strong tea may also be used 2. Give pentobarbital sodium, 6 to 9 grains, and repeat as needed 3. Do not attempt to perform gastric lavage if convulsions have begun
TURPENTINE:	Same as alcohol poisoning	Same as alcohol poisoning
WOOD ALCOHOL:	See Alcohol	See Alcohol

Chapter IV

NON-TRAUMATIC SYMPTOMS AND THEIR TREATMENT

The Hospital Corpsman has not been trained in many of the methods used to diagnose disease. For this reason, he must think of, and treat, diseases not as entities, but in terms of their symptoms. In order to facilitate this approach to disease, this chapter classifies symptoms as regional and general. Those symptoms which can be referred to a particular anatomical location are considered as regional, whereas those which pertain to the entire body are referred to as general.

Any discussion of disease and treatment designed for a man with limited training must, obviously, omit many controversial points, as well as omit some of the possible diagnoses. In cases where more than one diagnosis is possible, the Hospital Corpsman will usually consider the individual to be suffering from the disease or condition that is most dangerous to the patient and the welfare of the ship and treat him accordingly. The number of drugs available to the Hospital Corpsman, as well as Sick Bay equipment, is limited. The drugs and equipment necessary for the treatments recommended in this chapter have been limited to the drugs and equipment ordinarily supplied on United States merchant ships.

The Hospital Corpsman's duty is to sustain life and ease suffering until it is possible to transfer his patient to the care of one adequately trained in diagnosis and treatment. The reader will be constantly reminded of this fact by two statements. *Refer to a physician when available.* This statement is not intended to convey urgency, but is intended as a reminder to the Hospital Corpsman that he should refer his patient to a qualified physician when it is convenient to do so. *Seek the advice of a physician as quickly as possible.* This statement denotes urgency and the Hospital Corpsman should request the master to obtain advice from a physician. In peace time this advice can always be obtained by a radio to the nearest United States Marine Hospital. During war time a message can usually be signaled to a physician on a convoying vessel. When caring for patients who will be treated by a physician within eight hours, the Hospital Corpsman must use even greater discretion than usual in the administration of morphine, the sulfonamide drugs and

penicillin. Morphine tends to mask certain symptoms and signs. The sulfonamides or penicillin will make certain highly desirable laboratory tests unreliable. The treatment of these cases requires critical judgment. The Hospital Corpsman must decide whether or not the patient's condition justifies the use of these drugs despite the fact that they may confuse subsequent diagnosis.

HEAD

HEADACHE

SIMPLE—May be due to emotional disturbances, eye strain, anemia, or constipation.

Treatment: 1. Aspirin grains 10 (0.6 gram)—single dose.

RECURRENT—May be due to migraine, nasal obstruction, sinusitis, eye strain, nephritis, or other serious diseases.

Treatment: Mild.

1. Aspirin grains 10 (0.6 gram)—repeat as needed (limit 30 grains—2 grams).

Treatment: Severe.

1. Bed rest in dark room.
2. Ice bag to head.
3. Aspirin grains 10 (0.6 gram)—repeat as needed (limit 30 grains—2 grams).
4. Refer to a physician when available.

ASSOCIATED WITH FEVER—May be due to the onset of an acute infectious disease (measles, influenza, meningitis) or serious disturbances within the skull.

Treatment: Consider this patient to be in the early stage of an acute infectious disease.

1. Isolate in Sick Bay.
2. Bed rest.
3. Light diet.
4. Aspirin grains 10 (0.6 gram)—repeat as needed (limit 40 grains—2.6 grams).
5. Temperature every four hours.
6. Watch for skin rash, stiff neck, and other symptoms.

SWELLINGS OF THE HEAD

RECENT—If associated with pain, tenderness, and redness, it is probably an abscess.

Treatment: 1. Wet dressings using concentrated magnesium sulfate solution.

LONG DURATION—Probably due to a fatty tumor or sebaceous cyst.

Treatment: 1. Reassure patient that condition is not dangerous.

2. Defer treatment until physician is available.

FACE

PAIN IN THE FACE

LOCALIZED TO A SMALL AREA—May be due to a decayed tooth with irritation of its nerve or dental abscess. An examination of the mouth will reveal whether or not these conditions are present.

Treatment: 1. Refer to diseases of the Mouth.

If the pain is associated with localized swelling and redness, consider the pain as a symptom of an abscess or a boil (furuncle).

Treatment: 1. Hot, wet dressings of magnesium sulfate solution.

CONFINED TO ONE SIDE OR THE MAJOR PORTION OF ONE SIDE OF THE FACE—Probably due to neuralgia or neuritis.

Treatment: 1. Aspirin grains 10 (0.6 gram)—repeated at three-hour intervals.

2. Heat applied locally to painful area (hot water bottle or other form of dry heat).

PALLOR OF THE FACE

TRANSIENT—May be due to fright, fainting, acute hemorrhage, shock.

Treatment: 1. Have patient lie flat on back.

2. See general symptoms, for treatment of Collapse and Shock.

PERMANENT—May be the individual's normal appearance but is frequently a sign of chronic disease.

Treatment: 1. Refer patient to a physician when available.

EYE

BLACK EYE

WITHOUT INJURY OR AFTER VERY SLIGHT INJURIES—May be due to diseases of the blood or of the blood vessels.

Treatment: 1. Cold, wet compresses may be used if swelling and discoloration are of considerable degree.

2. Usually no immediate treatment is required.

3. Refer patient to a physician when available.

SWELLING OF THE EYELIDS

GENERAL—Swelling of one, and occasionally both eyelids, which appears suddenly and which may or may not be associated with hives, is probably due to an allergic state.

Treatment: 1. Cold, wet boric acid solution compresses to the eye.

2. Remove the substance, if known, causing the allergic condition.

3. Investigate the diet as a possible cause of the allergic state, and have patient avoid eating any questionable foods.

4. Magnesium sulfate, 2 tablespoonsful, for catharsis.

5. Calamine lotion or starch suspension applied to the skin, if hives are present.

6. If the condition is severe, and particularly when it is associated with swelling in the throat or difficulty in breathing, give 0.5 cc. (8 minims) adrenalin solution 1–1000 subcutaneously. Repeat this dose, if absolutely necessary, at one-half hour intervals not more than four times.

Figure 53. Swellings of the eyelid.

If this swelling is associated with general puffiness of the face, swelling of the ankles, headache, nausea and vomiting, dry skin, and scanty urine, consider the condition a symptom of kidney disease.

Treatment: 1. Bed rest.

2. Limit fluid intake to 1 quart (1000 cc.) daily.

3. Omit salt from the diet.

4. Seek the advice of physician as quickly as possible.

LOCALIZED—If swelling is localized in the margin of the eyelid and is associated with pain, tenderness, and redness, all of rapid development, consider the swelling to be a stye.

Treatment: 1. Hot boric acid compresses applied for forty minutes, four times a day.

2. Between compresses apply antiseptic eye ointment (bichloride of mercury or sulfathiazol).

If swelling develops slowly, is recurrent and hard, consider the swelling to be a cyst.

Treatment: 1. No treatment required unless infection develops in the cyst when the symptoms will become similar to those of the stye and the treatment is the same.

2. Refer patient to physician when available.

CRUSTED EYELIDS

Scales or crusts at the margin of both lids are often associated with partial loss of eyelashes.

Treatment: 1. Hot, wet compresses of boric acid solution.

2. Yellow oxide of mercury eye ointment gently rubbed into the eyelids night and morning.

BLOODSHOT EYES

FOREIGN BODY (cinder, dirt, sand, etc.)—The history of the cases will often decide whether the condition is due to a foreign body or not. However, a careful examination for a foreign body should always be made regardless of the history before it is decided that one is not present.

Treatment: 1. Remove foreign body with a moistened cotton applicator.

2. Irrigate eye with boric acid solution.

3. Attempts to remove foreign body by rubbing or the use of hard instruments will cause the foreign body to penetrate deeper into the eye and should not be used.

4. Anesthetic eye solution (tetracaine 0.5%) should be applied before attempting to remove the foreign body if spasm of the eyelids or considerable pain is present. The ordinary foreign body can be easily removed without the use of a local anesthetic. If a local anesthetic is used, cover the eye, until normal sensation returns, in order to protect the eye against further injury.

5. Should it prove impossible to remove the foreign body by the methods described above, relieve pain by the use of warm boric acid compresses and the application of antiseptic anesthetic eye ointment.

ASSOCIATED WITH DRAINAGE OF PUS—A symptom of an infection of the eye with pus-producing bacteria.

Treatment: 1. If only one eye is infected mask the uninfected eye to prevent its infection.

2. Warm boric acid solution irrigations followed by warm boric acid compresses for forty minutes four to six times a day.

3. Antiseptic eye ointment (bichloride of merucry or sulfathiazol) four to six times a day.

4. Irrigate with penicillin solution 500 units in 1 cc. of normal saline four times a day. Collect the overflow solution on a sterile gauze pad which should then be used as a covering until the next treatment.

5. Dark glasses or eye patch if there is pain in the eye on exposure to light.

If the individual has gonorrhea in addition to his eye infection consider the eye infection a symptom of gonorrheal ophthalmitis.

Treatment: 1. Bed rest.

2. If one eye is not infected, cover it to prevent spread of the infection.

3. Apply warm boric acid solution compresses and irrigations to the eye. Repeat every two hours to remove crusts and pus. Note—the eyelids may be so swollen that it will be impossible to do much more than superficially clean the eyelids and surrounding face.

4. After cleansing the eye, irrigate with penicillin solution 5,000 units in 10 cc. of normal saline. The solution of pencillin, after it is used to irrigate the eye, should be collected on a sterile gauze pad. Allow the pad to remain over the eye between periods of irrigation.

5. Begin penicillin treatment for gonorrhea at once.

6. The Hospital Corpsman must use precautions to prevent contamination of his own eyes.

Associated With Scanty or No Drainage of Pus—Probably a catarrhal conjunctivitis.

Treatment: 1. Boric acid solution irrigations four times a day followed by the application of an antiseptic eye ointment.

Bloodshot eyes associated with spasm of the eyelid, excessive tearing, aversion to light, and interference with vision are usually due to serious diseases of the eyeball.

Treatment: 1. Apply warm boric acid solution compresses for forty minutes, four times a day.

2. Keep affected eye covered at all times.

3. Apply antiseptic eye ointment four times a day following compresses, or

4. Irrigate with penicillin solution 500 units in 1 cc. of normal saline four times a day. Collect the overflow solution on a sterile gauze pad which should then be used as a covering until the next treatment.

5. If pain is severe use an antiseptic anesthetic eye ointment every four hours following the warm compresses.

6. Seek the advice of a physician as quickly as possible.

EAR

EARACHE

ASSOCIATED WITH OR FOLLOWING AN UPPER RESPIRATORY INFECTION - Earaches are quite commonly associated with infections of the upper respiratory tract and may be caused by infections ranging in severity from a mild catarrhal infection to an abscess of the middle ear. If there is little or no fever and the pain is not severe, consider the earache a symptom of a catarrhal infection.

Treatment: 1. Aspirin grains 10 (0.6 gram) repeated as needed; limit to 30 grains (2 grams) in eight hours.

2. Hot water bottle applied to ear.

3. Ear drops 3, repeated every three hours if needed.

If the earache becomes intense and the patient develops an increasing amount of fever, consider the condition a symptom of an abscess of the middle ear.

Treatment: 1. Aspirin grains 10 (0.6 gram) repeated as needed; if aspirin is not adequate for relief of pain give codeine sulfate grain 1 (0.06 gram) by mouth.

2. Ear drops 3, repeated every three hours if needed.

3. Hot water bottle to ear.

4. Sulfadiazine—first dose 60 grains (4 grams), subsequent doses 15 grains (1 gram) repeated every four hours until temperature becomes normal. Then reduce the number of doses to four daily. Stop when all symptoms have subsided or after ten days. Should symptoms recur, resume treatment as above. As an alternate for sulfadiazine;

5. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

If pus is present in the ear canal:

6. Remove pus from ear with cotton pledgets. Do not insert applicators or other hard instruments into the ear canal.

7. Blow sulfanilamide powder into the ear canal with an atomizer. Squeeze the bulb gently and do not insert the atomizer tip into the ear canal. Repeat twice a day after first removing as much pus as is possible. This local treatment should be continued for five days after all drainage

from the ear has stopped and should be continued even though the administration of the sulfadiazine by mouth or penicillin has been discontinued.

Associated With Pain Upon Manipulation of the Ear—Usually caused by an infection in the ear canal which may be diffuse or localized. Pain is usually ill-defined at first, but soon becomes localized and severe, and is intensified by chewing or by any manipulation of the ear. Fever is usually absent.

Treatment: 1. Aspirin grains 10 (0.6 gram)—repeat as needed; limit to 30 grains (2 grams) in eight hours.

2. Apply heat to the ear by means of a hot water bottle and hot compresses.

3. Ear drops 3, every three hours if needed.

Vague Earache—Vague pains in the ear are not uncommon and there may be no apparent explanation for them. They are sometimes associated with diseases of the throat, teeth, lymph glands of the neck, and mumps.

Treatment: 1. Examine throat, neck, and teeth carefully and treat in accordance with findings.

CHRONIC DRAINAGE

Intermittent or continuous drainage of pus from the ear indicates a chronic otitis media (middle ear infection).

Treatment: 1. Clean pus from the ear with cotton pledgets.

2. Refer patient to a physician when available.

ITCHING OF THE EAR

Usually caused by eczema or other skin diseases.

Treatment: 1. If the skin is scaly and crusted, apply boric acid ointment in small quantities twice daily.

2. If moist and fisurred, apply boric acid compresses for forty minutes twice a day then apply boric acid ointment.

DEAFNESS

Is usually the result of chronic disease and as such need not concern the Hospital Corpsman. It is also associated with acute conditions in the ear such as acute otitis media. A unilateral deafness which occurs abruptly, or deafness which is present for a few minutes or hours then is suddenly relieved only to occur again, is usually caused by wax plugging the external ear canal. The Hospital Corpsman, however, will

ordinarily not have adequate equipment or sufficient experience to remove this plug of wax and thus will be unable to do much to relieve the deafness. He can reassure the patient and should see to it that the patient consults a physician when one becomes available. A few drops of oil in the affected ear may be of slight benefit.

NOSE

PAIN IN THE NOSE

LOCALIZED TO A SMALL AREA—In the absence of trauma is probably a symptom of a small boil in the skin or mucous membrane.

Treatment: 1. Warm compresses with boric acid solution for forty minutes four times daily. Follow by the application of a small amount of boric acid ointment to the inflamed area.

GENERALIZED PAIN—If it is associated with stuffiness or nasal obstruction and located near the nose, consider it a symptom of an infection of the paranasal sinuses.

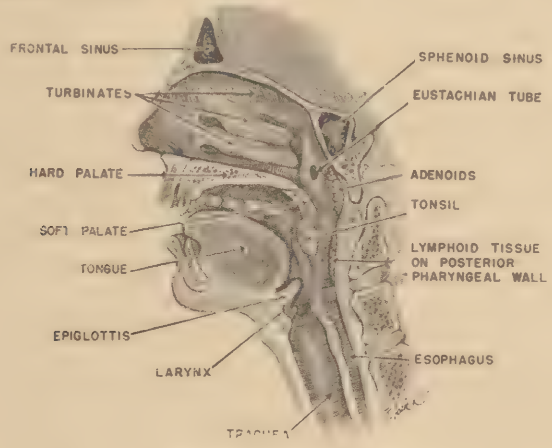


Figure 54. Diagram of upper respiratory tract.

Treatment: 1. Aspirin grains 10 (0.6 gram), repeat as needed every four hours.

2. Nose drops, 3 drops repeated as needed every three hours.

OBSTRUCTION OF THE NOSE

ACUTE—Is usually associated with an infection within the nose such as a common cold or sinus infection.

Treatment: 1. Nose drops, 3 drops, repeat as needed every three hours. Caution: Use nose drops as infrequently as possible since their effectiveness diminishes with continued use.

CHRONIC—May be caused by a mechanical obstruction in the nose or by a chronic sinus infection.

Treatment: 1. Nose drops, 3 drops, repeat every three hours if needed.

2. Refer patient to a physician when available.

WATERY DISCHARGE FROM THE NOSE

This condition should be considered as an early symptom of a "common cold" particularly if it is associated with fever, and generalized body aches. Treatment of the common cold:

Treatment: Mild (without fever).

1. Nose drops, 3 drops, repeat every three hours, if needed.

2. Aspirin grains 10 (0.6 gram), repeat as needed; limit 40 grains (2.6 grams) in one day.

3. Cough mixture 1 teaspoonful (4 cc.), repeat every two hours, if needed.

4. Prevent undue exposure, if possible.

Treatment: Moderate.

1. Partial bed rest.

2. No special diet is necessary.

3. Aspirin grains 10 (0.6 gram) four times a day.

4. Cough mixture 1 teaspoonful (4 cc.), repeat every two hours if needed.

5. Steam inhalations for forty minutes, three times a day.

6. A light cathartic (1 or 2 cascara tablets may be given if the patient's bowels have not moved recently.)

Treatment: Severe.

1. Same as for a moderate cold except that the patient must be kept in bed at all times.

2. Head facilities should be arranged so that the patient does not have to walk more than a very short distance.

3. Soft diet.

4. At least 3 quarts (3000 cc.) of fluids must be given daily.

5. Sulfadiazine grains 15 (1 gram), four times a day.

PUS DISCHARGE FROM THE NOSE

Usually a symptom of a sinus infection. This drainage may be the simple after-effect of a "common cold" or may be an indication of a serious, chronic infection of one or more of the paranasal sinuses.

Treatment: 1. Nose drops, 3 drops every three hours if needed.

2. If symptoms continue, refer to a physician when one becomes available.

NOSE BLEED

SPONTANEOUS—Very common in young individuals and may ordinarily be ignored. It is also one of the first signs of rheumatic fever, infectious diseases, or nasal infection. In older individuals, a severe nasal hemorrhage is often associated with high blood pressure.

Treatment: 1. Mild bleeding requires no treatment.

2. Have patient lie flat on his back.

3. Apply cold (ice or cold compresses) to nasal area.

4. Have patient refrain from blowing his nose or "snuffing" blood back into his throat.

5. If the above treatment is ineffective, gently pack the nose with sterile gauze.

MOUTH

LIPS

PAIN—Associated with a small amount of swelling is a common symptom preceding the eruption of fever blisters (herpes labialis). It commonly occurs following excessive drying or sunburn of the lips.

Treatment: 1. The best treatment is no treatment, however should the blisters become infected, apply sulfathiazol or boric acid ointment.

ULCERS—Due to the same causes as ulcers elsewhere. Should an ulcer persist for a longer period than fourteen days without evidence of healing, syphilis or cancer should be suspected.

Treatment: 1. Keep ulcer clean by applying boric solution compresses for twenty minutes twice a day.

2. Dust on sulfanilimide powder lightly.

3. If ulcer is painful and tends to dry and crack, apply boric acid ointment whenever necessary.

TEETH

SIMPLE TOOTH ACHE—A vague pain not localized to any particular tooth.

Treatment: 1. Aspirin grains 10 (0.6 gram)—limit to 30 grains (2 grams) daily.

TOOTH ACHE LOCALIZED TO ONE TOOTH—Often accompanied by sensitivity to cold.

Treatment: 1. Aspirin grains 10 (0.6 gram)—limit to 30 grains (2 grams) daily.

2. Fill the cavity of the painful tooth with a putty-like paste made of zinc oxide powder and eugenol or oil of cloves.

THROBBING TOOTH ACHE—Probably due to an abscessed tooth. Pain may be induced by either hot or cold and may be worse at night.

Treatment: 1. Aspirin grains 10 (0.6 gram)—repeat every four hours as necessary.

2. Codeine grain 1 (0.06 gram) by mouth—limit of three doses.

3. Holding cold fluids in the mouth may afford temporary relief.

4. Refer to dentist as soon as possible (tooth will probably require extraction; front tooth may be retained by having nerve canal treated).

If no dental care is available, swelling of the jaw may occur.

Treatment: 1. Hot saline irrigations.

2. Poultice with a prune soaked in hot water until drainage occurs.

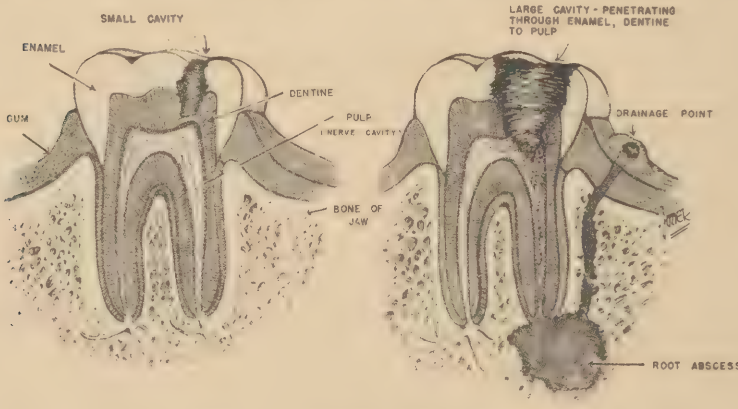


Figure 55. Common dental conditions.

GUMS

SWELLING OF THE GUMS—May be caused by food wedged between tooth and gum.

Treatment: 1. Remove the impacted food by use of dental floss or instrument.

2. Follow with hot irrigations of salt solution.

3. Vigorous tooth brushing and gum massage.

May be caused by an erupting tooth, especially third molar (wisdom tooth).

Treatment: 1. Vigorous tooth brushing.

2. Hot irrigations to the swollen part.

3. Penicillin, 5,000 units dissolved in 1.0 cc. of normal saline, held in mouth for thirty minutes and then swallowed, twice daily.

May be caused by a "gum boil" (an abscess around an infected tooth).

Treatment: 1. Hot irrigations of salt solution.

2. Small poultice such as a prune soaked in hot water and held over the area repeatedly until drainage occurs.

Simple Bleeding Gums—Slight bleeding from the gums (Gingivitis).

Treatment: 1. Diligent tooth brushing and gum massage.

2. Increase consumption of fresh fruits.

Spontaneous Bleeding—May be caused by Vincent's infection (trench mouth) which is characterized by small ulcers and erosions of the gum margins, particularly that portion of the gums between the teeth. It may be associated with pain in the gums, bad taste in the mouth, and a foul odor of the breath.

Treatment: 1. Clean mouth thoroughly with soap and water, twice daily, with as vigorous brushing as the condition of the mouth will permit.

2. Rinse mouth with hydrogen peroxide, 1 part to 4 parts water, or sodium perborate, 1 teaspoonful to a glass of water, six times a day.

3. Rinse the mouth with penicillin solution, 5,000 units in 1 cc. of normal saline, continue treatment for 30 minutes. This solution should be swallowed as it is used.

4. Increase consumption of fresh fruits.

5. Ascorbic acid tablets (Vitamin C), 75 milligrams daily.

Ulcerated Gums—Due to the same causes as Spontaneous Bleeding of Gums.

Treatment: Same as above.

JAW

Pain in the Jaw—Vague pains in the jaw or an unpleasant sensation in this area are not uncommon and usually indicate a diseased tooth.

Treatment: 1. See Simple Tooth Ache.

If tooth is not involved, the discomfort may be transitory.

Treatment: 1. Aspirin grains 10 (0.6 gram)—single dose.

Swelling of the Jaw—This condition may be associated with pain and is usually the result of an abscess of a tooth, but must be differentiated from a fracture of the jaw or mumps.

Treatment: 1. Aspirin grains 10 (0.6 gram), repeat every four hours, as necessary.

2. Hot wet dressings of magnesium sulfate solution to the swollen area for forty minutes, repeat four times a day.

3. Hot irrigations of salt solution, ½ teaspoonful in a glass of water, to the affected area, if an area of swelling can be detected in the mouth. Repeat four times a day.

Should the infection fail to localize, it may progress and result in a dangerous condition, characterized by marked swelling of the floor of

the mouth, elevation of the tongue, difficulty in swallowing, at times even difficulty in breathing, high temperature and a seriously ill patient.

Treatment: 1. Continue the treatment outlined above.

2. Sulfadiazine, initial dose grains 60 (4 grams), subsequent doses grains 15 (1 gram) at four hour intervals. Should the patient fail to respond in two days to sulfadiazine, institute treatment with Penicillin 20,000 units every three hours by intramuscular injection in addition to sulfadiazine. Should the patient's condition be extremely poor at the start, or become rapidly worse, penicillin should be started without delay.

3. Seek the advice of a physician as quickly as possible.

THROAT

SORE THROAT

Mild—A mild sore throat of recent origin accompanied by tickling and prickling sensations in the throat, slight difficulty in swallowing, and little or no fever should be considered a symptom of the "common cold." An examination of the throat reveals a mild diffuse redness with slight tonsillar enlargement if these organs are present.

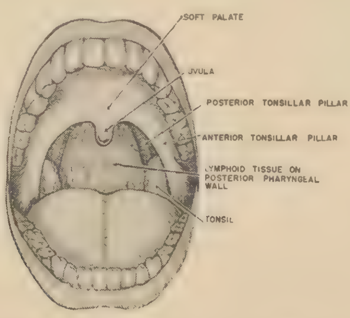


Figure 56. Diagram of oral pharynx.

Treatment: 1. Gargle with salt water or baking soda solution, ½ teaspoonful to one glass of water.

2. Nose drops, 3 drops four times a day if needed.

3. Refer to Watery Discharge from Nose for treatment of "common cold."

Severe—May be due to:

Streptococcic Sore Throat which is characterized by a rapid onset, temperature 102°–104°F., (38.8 –40°C.) generalized body aches, a feeling of sickness and enlarged red tonsils if these organs are present. The tonsils are often the site of multiple small ulcers as are the lymph

follicles on the back of the throat. The lymph glands of the neck are tender and easily palpated.

Scarlet Fever differs from the above only in the addition of a diffuse red skin rash and is to be treated in the same way.

Treatment: 1. Isolate in the Sick Bay in order to prevent the nasal and oral secretions of the patient from coming in contact with others.

2. Bed rest.

3. Liquid diet with copious fluids, 3 quarts (3000 cc.) daily.

4. Sulfadiazine, initial dose grains 60 (4 grams), subsequent doses grains 15 (1 gram) at four hour intervals. Continue this dosage until the temperature is normal and then give grains 15 (1 gram), four times a day for an additional two days at which time the drug should be stopped. As an alternate for sulfadiazine:

5. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

6. Warm throat irrigations or gargles with salt solution four times a day.

7. Refer to a physician when available.

Peritonsillar Abscess which is characterized by severe pain in one side of the throat and marked swelling of one tonsil. This swelling may be severe enough to greatly interfere with swallowing. Examination of the throat reveals marked swelling of one tonsil and its surrounding tissues including the uvula and adjacent portion of the palate.

Treatment: 1. Hot irrigations with salt or sodium bicarbonate solution every two hours.

2. Aspirin grains 10 (0.6 gram), repeat every four hours as needed.

3. Refer to a physician when available.

Trench Mouth which is characterized by fever 98.6°–102° F. (37°–38.8° C.), chilly sensations, feeling of sickness, and mild to severe pain usually located in one side of the throat. Examination of the throat ordinarily reveals a large dirty ulcer on one tonsil and occasionally on both. The lymph glands in the affected side of the neck are enlarged and quite tender.

Treatment: 1. Irrigate area with a warm solution of sodium perborate (one teaspoonful to a glass of water) every two hours during the day.

2. Apply penicillin, 5,000 units dissolved in 1 cc. of normal saline to the area with an applicator twice daily. The entire quantity should be used. This treatment should be given over a period of thirty minutes.

3. Refer to a physician when available.

NECK

HOARSENESS

ACUTE—Is usually a symptom of an upper respiratory infection such as a "cold" or influenza.

Treatment: 1. The same as for a common cold (see Watery Discharge from Nose).

2. Steam inhalations for twenty minutes, every four hours.

3. Keep in warm room.

4. Discourage use of voice.

CHRONIC—May be an indication of a serious chronic disease.

Treatment: 1. Refer patient to a physician when available.

NECK PAIN

In the absence of a history of injury, or absence of evidence of a beginning boil or carbuncle, consider the neck pain due to inflammation of muscles ("muscular rheumatism"). Muscle spasm with resulting tilting of the head and stiffness of the neck is common.

Treatment: 1. Apply dry heat to the neck for forty minutes, twice daily.

2. Rub on oil of wintergreen twice daily.

3. Protect the neck against exposure to cold or wet.

4. Aspirin grain 10 (0.6 gram), four times a day if needed.

STIFF NECK

Stiffness of the neck may ordinarily be considered a result of inflammation of the muscles of the neck and has been discussed under Neck Pain.

SWELLINGS OF THE NECK

Usually caused by enlargement of the lymph glands, enlargement of the parotid glands (Mumps) or enlargement of the thyroid gland.

ENLARGED LYMPH GLANDS—Are usually associated with infections of the tonsils, tooth infections, Vincent's angina, or diseases of the lymph glands. Examination of the patient's mouth will usually determine which of these factors is responsible for lymph gland enlargement.

Treatment: 1. Treat causative condition.

ENLARGEMENT OF THE PAROTID GLAND (MUMPS)—Is characterized by a tender, doughy swelling at the angle of the jaw. This swelling usually extends forward onto the face in front of the ear. The center of the swelling is located near the ear lobe. There is usually a mild fever.

temperature 100°–101.5° F. (37.8°–38.6° C.). Pain is present in the region of the swelling often before the swelling becomes noticeable. This pain is increased by chewing and by other movements of the jaw, particularly by eating.

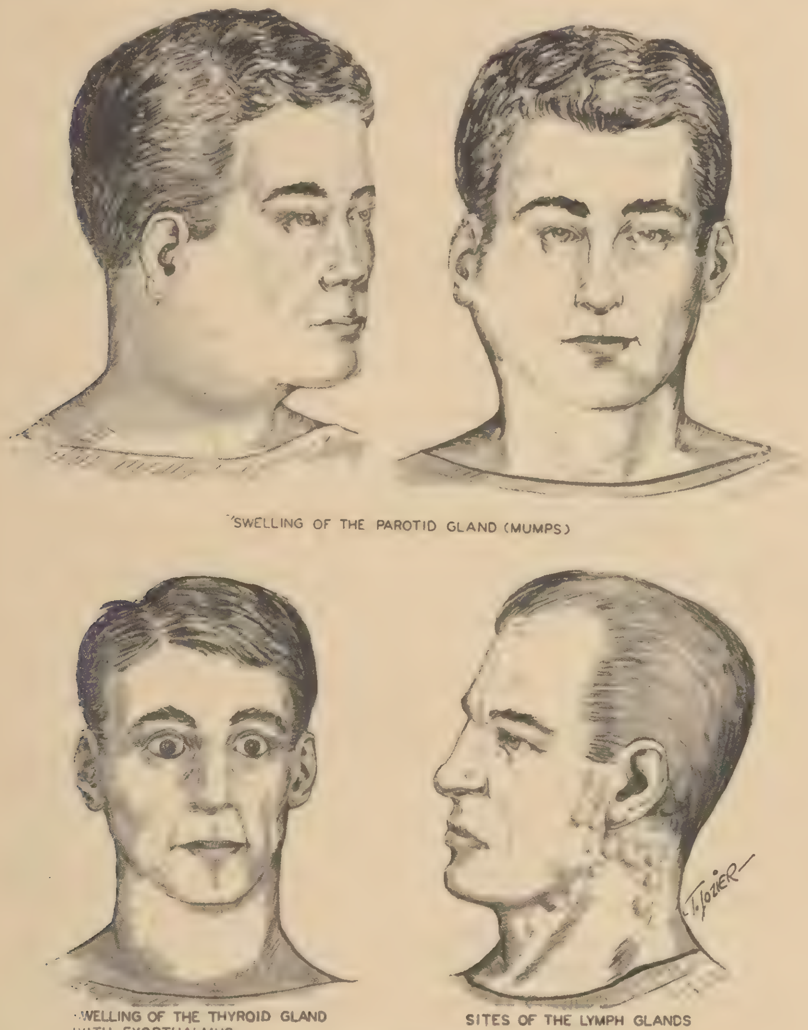


Figure 57. Common swellings of the neck.

Treatment: 1. Isolate in the Sick Bay until temperature and all swellings have disappeared.

2. Bed rest until temperature is normal.

3. Mouth wash with salt solution four times a day.

4. Patient may have any food to eat that is acceptable to him. He should drink a liberal amount of fruit juice each day even though it causes pain. These fruit juices may be diluted with water to make them more acceptable.

5. Watch for a spread of the infection to the opposite side of the face and to the testicles. Should either of these complications occur, continue the same treatment as above. Should one or both testicles become involved, elevation of the testicles on a pillow, or an adhesive scrotal sling, will afford considerable comfort to the patient.

Enlargement of the Thyroid Gland—Is usually characterized by swelling of the base of the throat. If this glandular enlargement is associated with nervousness excessive sweating, loss of weight and strength and a fine tremor of the hand, the patient has hyperthyroidism. If these symptoms are not present, no treatment is indicated until the patient can consult a physician.

Treatment for hyperthyroidism:

1. Phenobarbital grain 1/4 (0.015 gram), four times a day. This dose may be doubled if it is not effective.

2. Have the patient rest at least four hours, during the day, in addition to his eight hours sleep during the night.

3. Increase food consumption so that the patient does not lose weight. Note: Rather than allowing the patient to eat more at any one meal, it is better to give additional feeding between meals.

EXTREMITIES

PAIN IN A SINGLE JOINT

Acute—Acute pain in a joint or near a joint, not associated with an injury, should be considered a symptom of a burstitis or an arthritis. The Hospital Corpsman should remember that mild and very transient pains in single joints are quite common occurrences and are usually of no significance.

Treatment: 1. Dry heat to the affected joint.

2. Rub on oil of wintergreen.

3. Wrap flannel cloth or otherwise protect the affected joint against cold.

4. Limit movement of the joint by a sling, bandage, or other device.

5. Aspirin grains 10 (0.6 gram), every four hours if needed.

If the pain is associated with high fever and marked redness and swelling in the joint, it should be considered a symptom of an acute septic arthritis.

Treatment: 1. Bed rest.

2. Splint extremity with pillow or sandbag, to limit motion.

3. Apply continuous dry heat to the joint. A cradle equipped with an electric light bulb will prove effective for this purpose.

4. Aspirin grains 10 (0.6 gram), every four hours as needed.

5. Sulfadiazine grains 60 (4 grams), then grains 15 (1 gram), every four hours until the temperature is normal. Reduce the dose to grains 15 (1 gram), four times a day for two more days. If this treatment is not effective after a two-day trial period, stop the sulfadiazine.

or

6. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

7. Light diet and give at least 3 quarts (3,000 cc.) of fluids daily.

Chronic or Recurrent—It is probably caused by the same conditions listed under Acute Joint Pain.

Treatment: 1. If the pain is severe and associated with fever, treat as indicated for pain in a single joint; if the pain is severe and there is little or no fever, omit the sulfadiazine.

2. If the pain is mild use dry heat and rub on oil of wintergreen.

PAIN IN SEVERAL JOINTS

Stationary—Treat as indicated above, depending on whether or not there is associated fever and upon the severity of the pain.

Migratory—If the pain is severe, migrates from joint to joint, and is associated with elevated temperature, the patient probably has rheumatic fever.

Treatment: 1. Bed rest.

2. Aspirin grains 15 (1 gram) every three hours. Continue this dose until the temperature is normal or there has been considerable relief from joint pain. Then give aspirin grains 10 (0.6 gram) four times a day.

3. Light diet with milk and fruit juices between meals.

4. Keep patient in bed for at least two weeks after temperature has become normal and joint symptoms have disappeared.

5. Refer to a physician when available.

PAIN—OTHER THAN IN JOINTS

The only pains not associated with an injury that are apt to cause the Hospital Corpsman concern, are those due to neuritis or neuralgia.

These pains are characterized by variations in intensity, a tendency to follow the course of the nerve, associated prickling and tingling sensations, and, at times, muscular weakness.

Treatment: 1. Apply dry heat to the painful area.

2. Keep the affected area warm by covering with a sweater or other warm garment.

3. Rest the affected part by means of a splint or, if necessary, bed rest.

4. Diet rich in vitamin B_1.

5. Vitamin B_1 (thiamin chloride) if available, 25 mg. subcutaneously two times a day. A similar dose may be given by mouth if only tablets are available.

PARALYSIS

Involving Major Portions of the Body—A paralysis involving one-half, or a large portion of the body, particularly in individuals past 45 years of age, is probably a symptom of blood vessel disease in the brain (softening of the brain, apoplexy). Paralyses of this type may or may not be associated with loss of consciousness. The Hospital Corpsman should be prepared for the death of some of these patients.

Treatment: 1. Absolute bed rest.

2. Ordinarily use a liquid diet for the first few days. Do not attempt to feed an unconscious patient. Patient with a partial paralysis of the muscles of swallowing should not be fed by mouth for the first few days. Substitute subcutaneous and intravenous fluids.

3. Use precautions to prevent bed sores.

4. Refer patient to a physician as quickly as possible.

Paralysis of Muscle Groups—Paralyses of this type, in the absence of an injury and fever are due to a neuritis and may or may not be associated with pain. There is ordinarily an associated complaint of numbness and tingling. Paralyses of this type should be considered as a symptom of Vitamin B_1 deficiency.

Treatment: 1. See Pain in the Extremity, Other than Joint Pains.

2. Splint the part to prevent over-action of the non-paralyzed muscles.

3. Refer to a physician when available.

VARICOSE VEINS

No treatment is indicated unless the varicosities are causing symptoms.

Treatment: 1. Apply elastic bandage.

2. Refer to a physician when available.

When associated with ulcer.

Figure 58. Varicose ulcer.

Treatment: 1. Clean ulcer and apply warm boric acid solution compresses for forty minutes.

2. Boric acid ointment pressure dressings.

3. Elastic bandage.

If there is an infection or marked swelling in the leg in association with varicose ulcers.

Treatment: 1. Bed rest.

2. Elevate leg.

3. Continuous warm wet compresses of boric acid solution.

SWELLING OF THE FEET AND LEGS

Swelling of One Lower Extremity—The Hospital Corpsman should consider this condition to be the result of inflammation of the veins particularly when there is associated pain in the leg and fever.

Treatment: 1. Bed rest.

2. Elevate foot and leg on pillows.

3. Apply continuous warm boric acid solution compresses.

4. Sulfadiazine grains 60 (4 grams) initial dose, then grains 15 (1 gram) every four hours until temperature is normal, then grains 15 (1 gram) four times a day for two days at the end of which time this treatment should be discontinued.

or

5. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

6. Refer patient to a physician when available.

Swelling of Both Lower Extremities—Swelling of both lower extremities, if at all extensive, is indicative of a serious disturbance of the circulation of blood in the lower extremities. This symptom usually indicates heart disease and is commonly associated with such symptoms as shortness of breath, cough, and rapid and often irregular pulse.

Treatment: Severe Swelling.

1. Bed rest with patient in a sitting or semi-sitting position.
2. Elevate feet on pillows.
3. Restrict fluid intake to one quart daily.
4. Soft diet without salt.
5. Seek the advice of a physician as quickly as possible.

Treatment: Mild Swelling.

1. Limit duties to light work that does not cause shortness of breath.
2. Restrict fluid intake to one and one-half quarts daily.
3. Salt-free diet.
4. Refer to a physician when available.

ENLARGED LYMPH GLANDS

Not Associated with Infection—In the absence of a regional infection, the Hospital Corpsman should consider the enlarged lymph glands as caused by a disease of the lymphatic system. If the patient has other symptoms, treatment should be directed toward the alleviation of these symptoms. If other symptoms are not present, no treatment is needed, except to refer him to a physician when one becomes available.

Associated with Infection—Enlargement of the lymph glands in the inguinal and femoral regions are frequently found in association with ulcers of the penis. For treatment of these conditions refer to Ulcers Of The Genitalia. Other infections in the extremities responsible for lymph gland enlargement may be considered as one group regardless of the numerous sites in which they are found. The treatment of these

infections and the resulting lymph gland enlargements will depend upon whether the infection is mild or severe.

Treatment: Mild infections—Characterized by pain, tenderness, redness and increased skin temperature at the site of the infection with mildly tender lymph gland enlargement.

1. If the infected area is an open wound, apply boric acid compresses twice a day, for forty minutes, and dress the wound with boric acid ointment following each application.

2. If the infected area is closed, apply continuous warm boric acid solution compresses.

3. Prevent excess and unnecessary motion in the affected extremity by the use of splints or slings.

Treatment: Severe Infections—Characterized by pain, redness, tenderness, increased skin temperature at the site of the infection, red tender streaks extending up the extremities from the infection, large tender lymph glands, fever, and a general sensation of sickness.

1. Bed rest.

2. Light diet—fluid intake of at least 3 quarts (3,000 cc.) daily.

3. Sulfadiazine grains 60 (4 grams), then grains 15 (1 gram) every four hours until the temperature returns to normal. Then give grains 15 (1 grm) four times a day for two days.

or

4. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

5. Elevate infected extremity on pillows.

6. Apply continuous warm boric acid solution compresses if there is an infected open lesion.

INGROWN TOENAIL

Without Infection—

Treatment: 1. Trim the nail so that the edge is straight and projects beyond the lateral folds of the skin.

2. Wear shoes and socks that do not crowd and pinch the toes.

3. Pack a small wick of vaseline gauze between the edge of the nail and the skin in such a manner as to mildly evert (turn out) the edge of the nail.

Associated with Infection—

Treatment: Mild.

1. Warm boric acid solution soaks for forty minutes twice daily.

2. Pack a small wick of vaseline gauze between the edge of the nail and the skin in such a manner that the edge of the nail is mildly everted.

3. Wear shoe with cut-out toe.

4. Trim nail so that edge is straight and projects beyond the lateral folds of the skin.

Treatment: Severe.

1. Bed rest.

2. Continuous warm boric acid solution compresses.

3. If there is lymph gland enlargement and red streaks up the extremity and fever, treat as indicated under Lymph Gland Enlargement.

GANGRENE

Gangrene usually begins as a small area of ulceration which dries forming a black crust and gradually spreads to the surrounding tissues. The causes of gangrene are numerous and the eventual treatment varies with the cause. However, the treatment that is given by the Hospital Corpsman will be the same in all cases.

Treatment: 1. Bed rest.

2. Slightly elevate the gangrenous extremity with pillows.

3. Protect the gangrenous area from injury by the bed clothes by means of a "cradle."

4. Sprinkle sulfanilamide powder on the gangrenous area and exert every effort to prevent infection.

5. Should a secondary infection develop in the gangrenous area, apply continuous boric acid solution compresses (solution should be at room temperature).

6. If pain is severe give morphine sulfate grain 1/4 (0.015 gram) by hypodermic, repeated not more frequently than every four hours.

7. Keep the affected extremity at room temperature and *do not apply hot* compresses or *heat.*

8. Seek the advice of a physician as quickly as possible.

9. The Hospital Corpsman should be prepared for the death of such a patient.

CHEST

COUGH

Acute with Fever—Consider this as a symptom of a respiratory infection which may vary from a mild cold to a fatal pneumonia. The control of the cough is secondary in importance to the control of the infection. The following treatment refers only to the control of the cough.

Treatment: 1. Cough syrup, 1 teaspoonful (4 cc.) repeated every two hours as needed.

2. Keep the patient in a warm room.

3. Steam inhalation for thirty minutes, four times a day. A small quantity of tincture of benzoin may be added to the water.

4. Frequent sips of warm water are very helpful in the control of a spasmodic type of cough.

5. Codeine, grain 1 (0.06 gram), by mouth or hypodermic may be given to patients with a severe cough which cannot be controlled by other means. This treatment is reserved for those patients whose recovery may be jeopardized by severe coughing.

ACUTE WITHOUT FEVER—Commonly associated with mild upper respiratory infections, but may be an early symptom of heart or lung disease. The treatment of the patient will depend upon the cause of the cough and the other symptoms present.

Treatment: Cough syrup as outlined above.

CHRONIC—Commonly associated with chronic diseases of the upper respiratory tract (nose and throat) as well as diseases of the lungs and heart. No treatment is necessary for this symptom other than an occasional dose of cough syrup, unless other symptoms are present.

Treatment: 1. Cough syrup, 1 teaspoonful (4 cc.) as needed.

2. Refer patient to a physician when one is available.

EXPECTORATION OF BLOOD

It is extremely important for the Hospital Corpsman to differentiate between the expectoration of blood (hemoptysis) and the act of vomiting blood. In general, hemoptysis is accompanied by a history of cough or other symptoms of lung and heart disease; whereas hematemesis is associated with a history of indigestion. Blood that is coughed up is usually bright red in color, frothy and often mixed with mucus and pus. (Following the original hemorrhage, the sputum is often blood tinged for several days and the cough may persist for some time.) If blood is vomited, it is often clotted, mixed with particles of food, and is dark in color. Following a hemorrhage from the gastro-intestinal tract, the stools are tar-colored for several days.

Expectoration of blood usually indicates lung or heart diseases; common examples are lung tumors, tuberculosis, and rheumatic heart disease. The sputum is blood streaked, blood tinged, or mixed with blood in many infections of the nose, mouth, pharynx, larynx and bronchi. The treatment that follows is intended for the control of definite bleeding of respiratory origin.

Treatment: 1. Absolute bed rest.

2. If the hemorrhage is severe and the patient greatly upset, morphine sulfate grain 1/4 (0.015 gram) by hypodermic injection.

3. Cough syrup with codeine, 1 teaspoonful (4 cc.) every three hours as needed to relieve, but not to abolish the cough.

4. Diet should be light and small in quantity.

5. Seek the advice of a physician as soon as possible.

TIGHTNESS IN THE CHEST

WITH FEVER—A sensation of tightness under the breast bone (sternum) in the presence of fever and cough, particularly following an upper respiratory infection (common cold, sore throat) is a symptom of a tracheitis, bronchitis, or bronchial pneumonia. Individuals with these conditions may become very sick. A few persons will be mildly ill. The Hospital Corpsman should treat these patients according to the degree of the associated systemic symptoms (fever, rapid pulse rate, general feeling of illness, exhaustion).

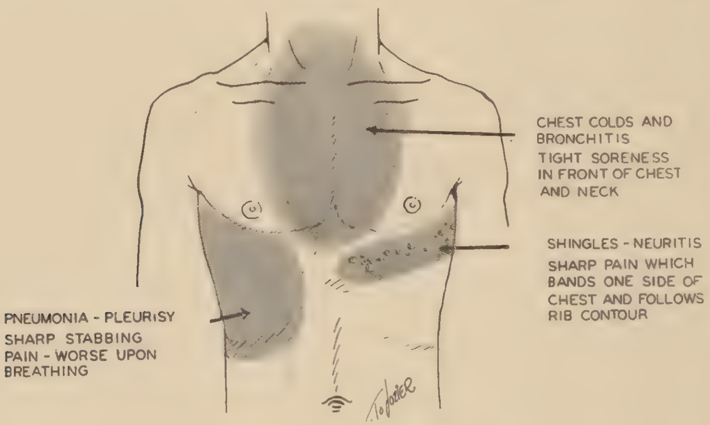


Figure 59. Chest pain.

Treatment: 1. Control cough with expectorant cough mixture, 1 teaspoonful. Repeat at two hour intervals if needed.

2. Give steam inhalations for forty minutes twice daily. A small amount of tincture of benzoin may be added to the water, if desired.

3. Have patient sleep in a warm room and prevent exposure to cold and wet weather.

4. Bed rest in accordance with the severity of the symptoms. Patients with temperatures about 100.5° F. (38.0° C.) shuold, at least, be at partial bed rest in the Sick Bay.

5. Sulfadiazine, if the patient is mildly ill (temperature less than 100.5° F.–38.0° C.) give none. If moderately ill (temperature above 100.5° F.–38.0° C.) give grains 15 (1 gram), four times a day. If severely ill (temperature above 103° F.–39.6° C.) give grains 60 (4 grams), then grains 15 (1 gram) at four hour intervals until temperature is normal for two days.

or

6. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

Without Fever—Occasionally persons with mild attacks of bronchitis or tracheitis will have little or no fever. These patients should be treated in the manner described above except that sulfadiazine or penicillin should not be given. Other causes for sensations of tightness in the chest are emotional disturbances and, rarely, serious diseases of the lungs and circulatory system. In these cases, the individual's condition will be such that treatment may be delayed until the patient can be referred to a physician.

Heart burn (acid indigestion) may at times be interpreted as "tightness in the chest." In the absence of abdominal pain, this condition may be treated by the administration of sodium bicarbonate or other antacid drugs.

PAIN IN THE SUBSTERNAL REGION OF THE CHEST

Pain in the sternal region of the chest, or as it is more commonly expressed, the sub-sternal region of the chest, is usually an indication of serious heart disease.

Transitory—Pain or soreness in the substernal region of the chest is a frequent accompaniment of influenza, bronchitis, and tracheitis. The characteristics and treatment of these conditions is described under Tightness Of The Chest. Pain in this area, that is crushing, tearing, or dull and grinding, and is commonly associated with shortness of breath and fear of dying, should be considered as evidence of serious heart disease (angina pectoris). This pain is commonly referred to the left shoulder and down the left arm. It may be referred to the neck, the right shoulder, the head, and other parts of the upper extremities and occasionally to the abdomen.

Treatment: 1. Nitroglycerin tablet, grain 1/150 (0.4 mg.), dissolved under the tongue.

2. Have the patient sit quietly until attack subsides.

3. Prevent future attacks by having the patient limit his activities.

4. Refer to a physician when available.

PERSISTENT SUBSTERNAL CHEST PAIN—An attack of substernal chest pain, that is typical of angina pectoris, but which persists and is associated with physical collapse and later with fever, indicates an even more serious heart disease, coronary thrombosis.

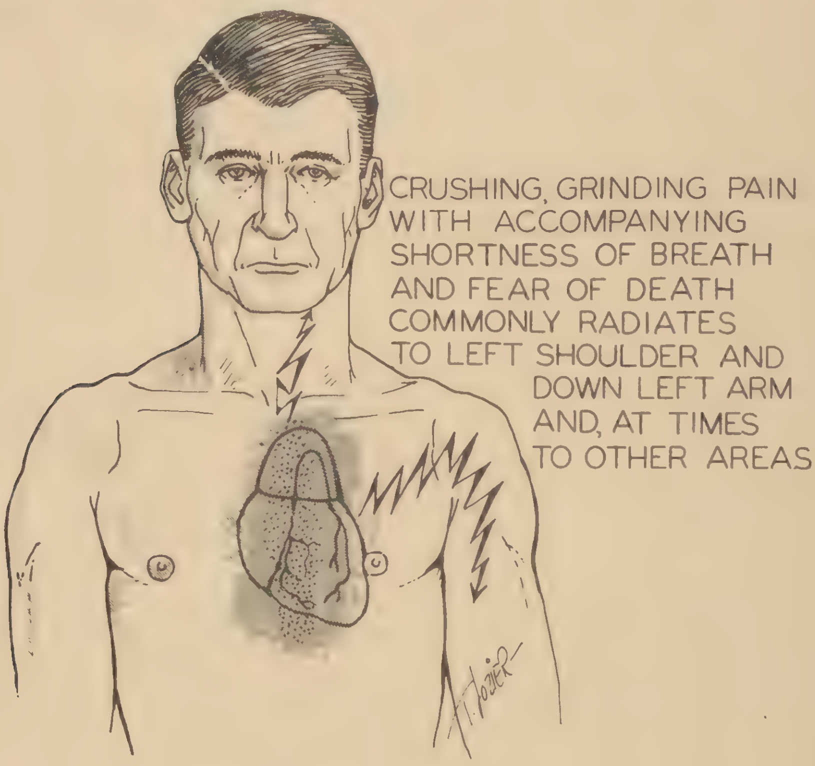


Figure 60. "Heart" pain.

Treatment: 1. Absolute bed rest.

2. Morphine grain ¼ (0.015 gram) repeated at four-hour intervals until the pain is relieved.

3. Diet, very light and small in quantity.

4. If the patient survives, maintain bed rest from six to eight weeks or until he has been turned over to the care of a physician.

5. Seek the advice of a physician as quickly as possible.

PAIN IN THE SIDE OF THE CHEST

WITHOUT FEVER—Pain not associated with injury or fever may be due to neuralgia of the intercostal nerves, herpes zoster (shingles) or several other conditions.

Treatment: 1. Aspirin grains 10 (0.6 gram), repeated at four hour intervals if necessary.

2. Strap chest if pain is made worse by breathing.

3. Refer to a physician when available, if symptoms persist.

WITH FEVER—Pain in the side of the chest, accompanied by a chill, temperature of 102—104 F. (38.8—40 C.); cough with sputum and a history of a respiratory infection should be considered a symptom of pneumonia.

Treatment: 1. Absolute bed rest.

2. Very light diet with at least 3 quarts (3000 cc.) of fluids daily.

3. Sulfadiazine grains 60 (4 grams), initial dose, then grains 15 (1 gram) every four hours until temperature returns to normal. Reduce the dose to grains 15 (1 gram) four times a day, for two more days then discontinue the drug.

or

4. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

5. Codeine grain 1 (0.06 gram), for cough if it is interfering with sleep or with the recovery of the patient.

6. Seek the advice of a physician as quickly as possible.

SHORTNESS OF BREATH

Shortness of breath is a normal accompaniment of emotional stress and physical exertion. Rapid, shallow breathing is frequently seen in patients with fever. It may also be found in neurotic individuals, who in addition may display other peculiar types of breathing such as sighing or intermittent gasping. With these exceptions kept in mind, shortness of breath should be considered as evidence of serious disease and careful attention should be given to the patient.

WITHOUT FEVER—Gradually increasing shortness of breath after exertion especially when associated with cough and swelling of the feet, should be considered as evidence of heart disease.

Treatment: See Swelling of the Feet.

May also be caused by mechanical obstruction which may result from a foreign body (the history will be indicative of this fact) or disease

within the chest, causing pressure on the breathing apparatus (aneurysm, tumor, or collapse of the lung). Treatment depends upon the cause of the shortness of breath, and in most cases this will be difficult to determine.

Treatment: Foreign Body.

1. Dislodge the foreign body, if present, by striking the person on the back or by carefully removing the foreign body with fingers or forceps.

Treatment: Other Causes.

1. Allay apprehension by conversation and the administration of phenobarbitol grain 1/4 (0.015 gram) to grains 1 1/2 (0.09 gram), two to four times a day.

2. Rest in bed or restriction of work depending upon the needs of the patient.

3. Refer to a physician when one is available.

ASSOCIATED WITH NOISY RESPIRATION—The usual cause of shortness of breath, associated with wheezing, is asthma. This condition is characterized by paroxysms of markedly difficult breathing, in which inspiration is short and jerky and expiration is greatly prolonged. Examination of the chest will reveal very little respiratory movement, in spite of the desperate efforts of the patient to breathe. This apparent paradox is produced by the already-present distention of the lungs with air.

Treatment: During an attack.

1. Have the patient sit in a chair or prop him up in a sitting position in bed.

2. Adrenalin 0.5 cc. (8 minims) subcutaneously, repeat in one-half hour if necessary. Do not repeat for more than four doses.

3. Refer to physician when available.

WITH FEVER—Shortness of breath associated with fever may be due to many conditions. It is usually an indication of serious disease of the lungs, heart or circulatory system. If acute, it is usually an indication of an infection of the bronchi or lungs, (bronchial penumonia, lobar pneumonia and pleural effusion).

Treatment: Acute.

1. Treat in accordance with the severity of the symptoms as outlined under Tightness in the Chest.

Treatment: Chronic.

1. Refer to physician when available.

2. Confine patient to Sick Bay.

3. Restrict activity of the patient in accordance with the severity of his symptoms.

ABDOMEN

GENERALIZED ABDOMINAL PAIN

Associated With Diarrhea—This condition is most commonly caused by food poisoning. In its milder form it is often the result of an emotional disturbance. There are also several serious gastro-intestinal conditions such as the dysenteries, typhoid fever, and partial intestinal obstruction that are characterized by generalized abdominal pain and diarrhea.

Treatment: 1. No cathartic until the patient has been observed for twenty-four hours and the Hospital Corpsman is satisfied that the patient does not have appendicitis.

2. Soap suds enema.

3. Limit diet to liquids until diarrhea has improved. Then soft foods, such as toast, eggs, tea, custards and cream soups may be added. This diet should be continued for twenty-four hours after all symptoms have subsided before giving the patient a regular diet.

4. If the diarrhea persists for more than twelve hours give a level teaspoonful of bismuth subcarbonate four times a day. Two teaspoonfuls (8 cc.) of paregoric may be substituted for the bismuth subcarbonate or given in conjunction with it.

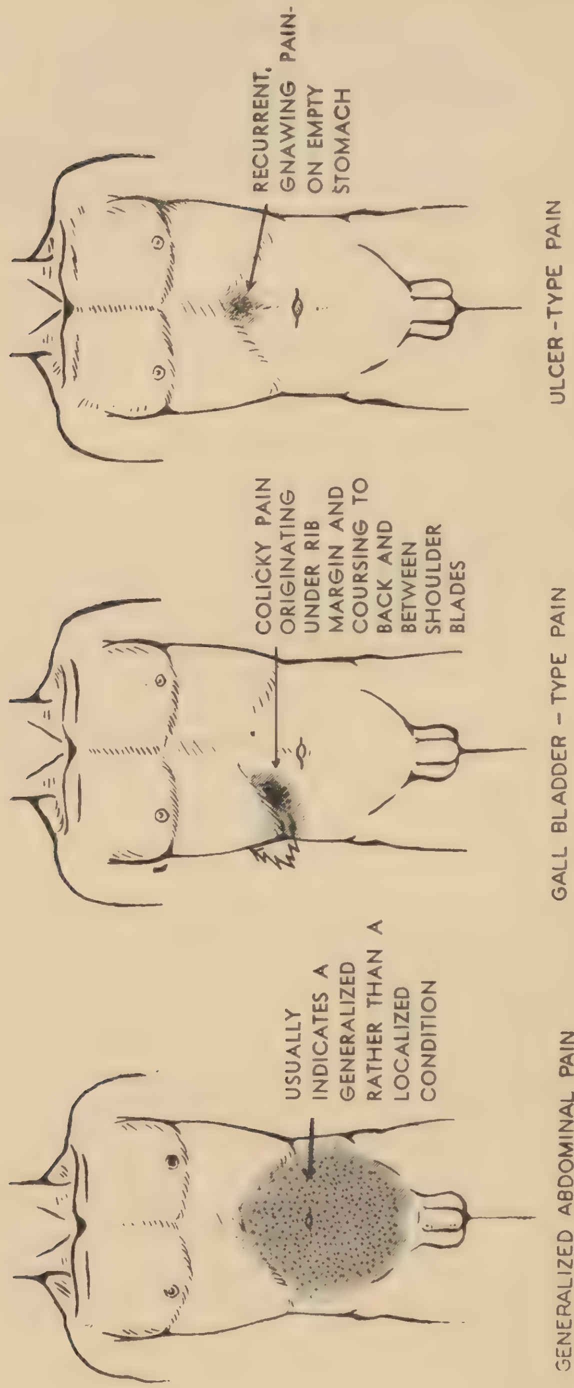
5. If the patient develops fever and symptoms persist, give sulfadiazine grains 15 (1 gram), four times a day. This treatment should be continued for twenty-four hours after all symptoms subside, or should be discontinued after four days, if found ineffectual.

6. If symptoms persist seek the advice of a physician as quickly as possible.

Associated With Constipation—This condition may be due to numerous factors, most of which the Hospital Corpsman will be unable to treat successfully. His chief concern in contending with this symptom will be one of reassuring the patient and referring him to a physician when one is available.

Associated With Fever—May be due to same causes discussed under Associated with Diarrhea and to a great extent the treatment is the same. If fever is present and associated with generalized abdominal pain, particularly if several members of the crew are affected, the Hospital Corpsman must consider the possibility of an epidemic of bacillary dysentery or typhoid fever. He should take necessary precautions to prevent the spread of the disease to healthy members of the crew.

Treatment: See Generalized Abdominal Pain Associated With Diarrhea.


USUALLY INDICATES A GENERALIZED RATHER THAN A LOCALIZED CONDITION
GENERALIZED ABDOMINAL PAIN
COLICKY PAIN ORIGINATING UNDER RIB MARGIN AND COURSING TO BACK AND BETWEEN SHOULDER BLADES
GALL BLADDER – TYPE PAIN
RECURRENT, GNAWING PAIN-ON EMPTY STOMACH
ULCER-TYPE PAIN

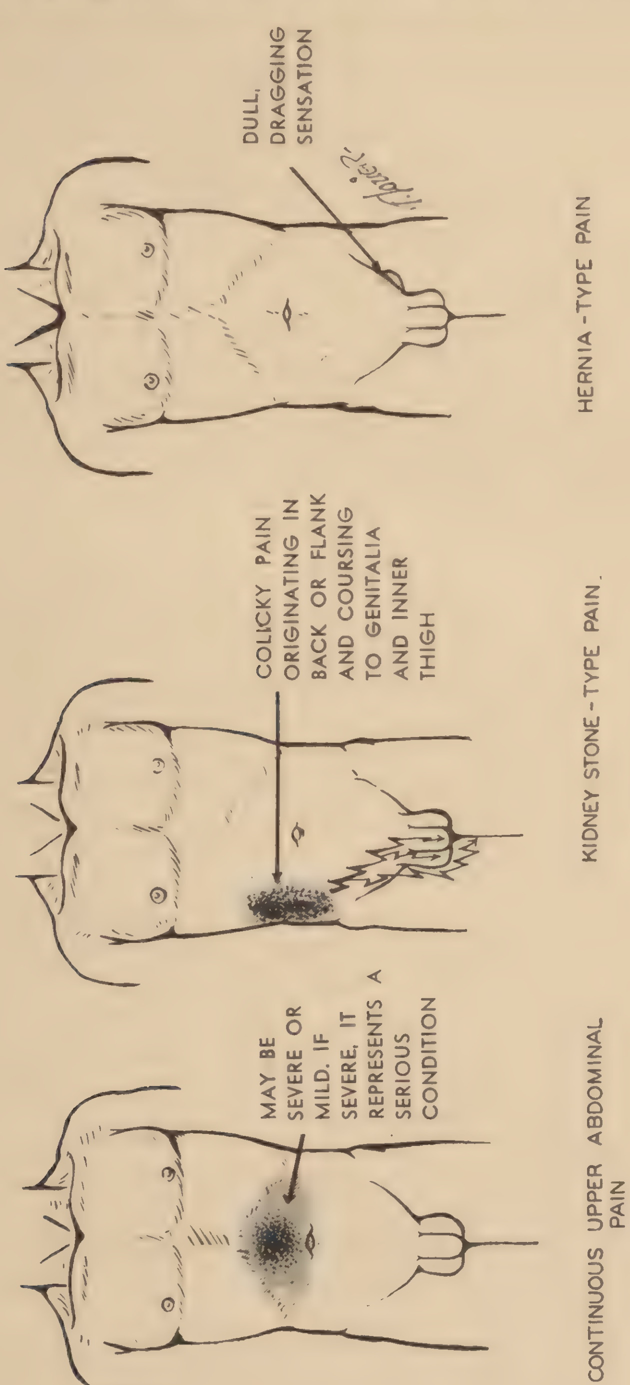


Figure 61. Abdominal pain.

PAIN LOCALIZED IN UPPER ABDOMEN

SPASMODIC OR COLICKY PAIN—Particularly when localized in the right upper quadrant of the abdomen, is probably the result of gall stones. This condition is usually associated with indigestion and jaundice. Fever when present is ordinarily of slight degree.

Treatment: 1. If the pain is severe, give morphine grain 1/4 (0.015 gram) and repeat in one hour if necessary.

2. Bed rest.

3. Light soft diet.

4. If the patient develops a fever over 101° F. (38.3° C.) give sulfadiazine grains 15 (1 gram) every four hours.

or

5. Give penicillin 20,000 units in 1 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

6. Seek the advice of a physician as quickly as possible if symptoms do not subside promptly.

RECURRENT PAIN—In the upper mid-abdomen, particularly if it occurs when stomach is empty, and is of a gnawing type, may be due to an ulcer in the stomach or duodenum (peptic ulcer).

Treatment: 1. Limit the diet to soft, mildly seasoned foods and give milk between meals and at bed time.

2. Sodium bicarbonate, 1 teaspoonful, may be used if the pain is not successfully controlled by diet. If aluminum hydroxide gel or tablets are available, they should be used in preference to sodium bicarbonate.

3. Refer to a physician when one is available.

CONTINUOUS PAIN OR RELATIVELY CONTINUOUS PAIN—Of the upper abdomen may be the result of several conditions, some serious and others which will not be of immediate danger to the patient. The Hospital Corpsman will of necessity have to treat these persons in accordance with the severity of the symptoms.

Treatment: Mild.

1. Reassure the patient.

2. Light soft diet.

3. Phenobarbital grain 1/4 (0.015 gram), four times a day if the patient is extremely apprehensive.

4. Refer the patient to a physician when one becomes available.

Treatment: Severe.

1. Bed rest.

2. Limit diet to liquids.

3. Give morphine grain 1/4 (0.015 gram). This dose may be repeated if necessary. The interval between doses should not be less than four hours.

4. If the patient develops fever give sulfadiazine, initial dose grains 60 (4 grams), subsequent doses grains 15 (1 gram) at four hour intervals.

or

5. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

6. If the patient is vomiting and unable to retain fluids when given by mouth, give 1000 cc. (1 quart) of normal saline subcutaneously (hypodermoclysis), or 1000 cc. (1 quart) of 5% glucose solution intravenously, twice a day.

7. Seek the advice of a physician as quickly as possible.

PAIN LOCALIZED IN THE LOWER ABDOMEN

Spasmodic or Colicky Pain Which originates in the back or flank, then crosses onto and down the abdomen to the genitalia or the inner surface of the thigh, is probably a symptom of a kidney stone. This pain may be mild or extremely severe. It may be associated with nausea, vomiting, profuse sweating, faintness and even with shock. There may be a slight amount of fever, a desire to urinate frequently and blood in the urine (hematuria).

Treatment: 1. If the pain is severe, give morphine grain 1/4 (0.015 gram). Repeat this dose once in 45 minutes, if necessary.

2. Have the patient drink 3 quarts (3000 cc.) of fluids daily.

3. If fever and other signs of infection appear give sulfadiazine grains 15 (1 gram), four times a day.

or

4. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

Continuous or Relatively Persistent Pain—Is usually associated with inflammatory diseases of the intestine. The most common of these conditions is appendicitis. Abdominal pain in appendicitis usually starts as a vaguely localized pain in the center of the abdomen. It later becomes localized in the right lower quadrant. Nausea, vomiting, slight fever and abdominal tenderness are other prominent symptoms. The

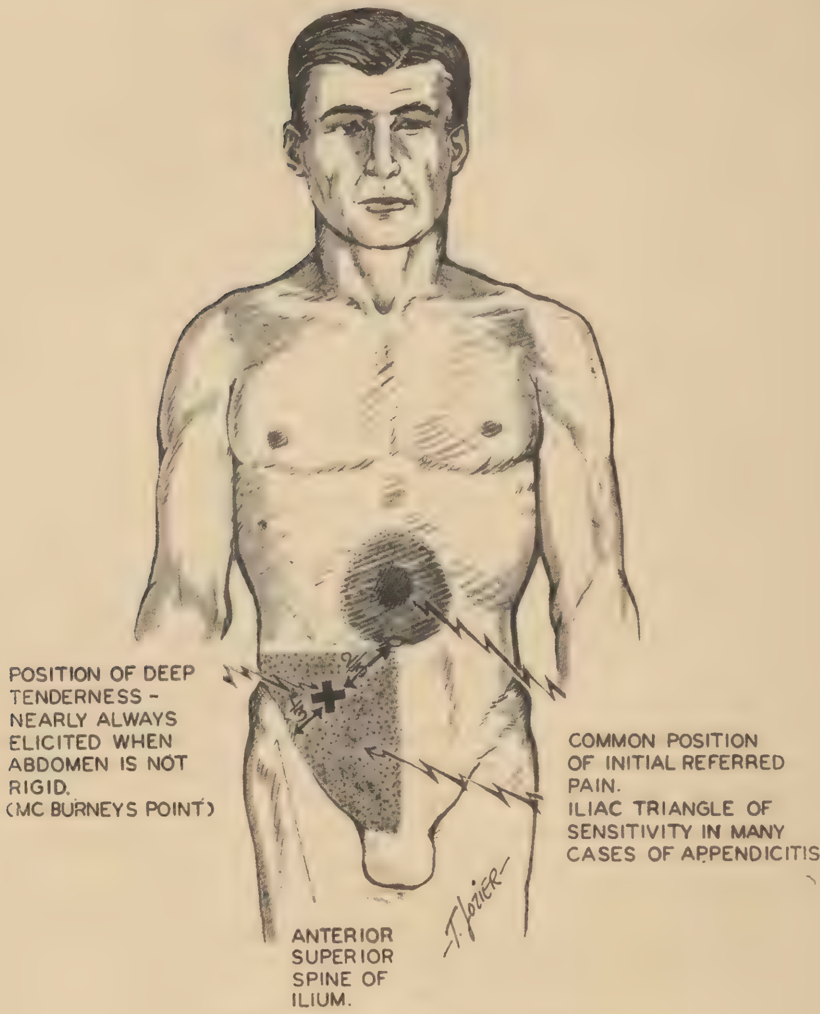


Figure 62. "Appendicitis-type" pain.

point of maximum tenderness in the abdomen is located at a point one-third of the distance from the anterior superior spine of the ilium to the umbilicus (McBurney's Point). Pains that are localized in other areas of the lower abdomen, provided they are relatively severe and are associated with signs of infection, should be treated in the same manner as a case of suspected appendicitis.

Treatment: 1. Place the patient in bed in a semi-sitting position with knees slightly elevated (Fowler's Position).

2. Apply an ice bag to the painful region.

3. Limit the diet to very small quantities of water given at half-hour intervals. Strained sweetened fruit juices, clear soups and coffee may be substituted for water. Other items of diet may be added as the patient improves.

4. Never give a cathartic.

5. Seek the advice of a physician as quickly as possible.

If the patient develops a fever that persists, rigidity of the muscles of the abdomen, and other signs of a progressing infection in addition to the above treatment, give:

1. Sulfadiazine, initial dose grains 60 (4 grams), subsequent doses grains 15 (1 gram) at four hour intervals.

or

2. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

3. 1000 cc. (1 quart) of normal saline subcutaneously (hypodermoclysis) or 1000 cc. (1 quart) of 5% glucose solution intravenously, twice daily.

SWELLING OF THE ABDOMEN

Localized—May be a symptom of ruptures (hernias) or tumors of the abdominal wall. (Treatment of these tumors may be safely delayed until arrival in port.) Adjustable trusses are available on merchant ships and one may be used if the patient desires it. The truss should always be applied when the patient is lying down and the hernia has been reduced, that is, the abdominal contents which have protruded into the hernial sac are placed back into the abdomen. The chief danger of a hernia is the possibility of strangulation. This condition is characterized by the sudden onset of pain at the site of a pre-existing hernia, a tender abdominal swelling, nausea, later vomiting, symptoms of collapse or shock (pallor, cold sweat, rapid weak pulse, fainting).

Treatment: Reduction of Hernia.

1. Bed rest flat on back with feet elevated so that gravity will aid in the reduction of the hernia.

2. Gentle manual pressure over the site of swelling.

3. If the above treatment is unsuccessful and the condition has been present for over an hour, apply an ice bag to the protrusion and give morphine grain 1/4 (0.015 gram), in addition to the above treatment.

4. Hold hernia in place by a truss or appropriate bandage after its reduction.

5. Assign to light duties after 48 hours.

If the attempts to reduce the hernia are unsuccessful, the patient may develop signs of an intestinal obstruction (continuous abdominal pain, vomiting, abdominal distention, fever and other signs of systemic toxicity).

Treatment: 1. Seek the advice of a physician as quickly as possible.

2. Relieve pain with morphine grain 1/4 (0.015 gram) repeated as needed.

3. 1000 cc. (1 quart) of normal saline subcutaneously (hypodermoclysis) or 1000 cc. (1 quart) of 5% glucose solution intravenously, twice daily.

RECTUM

HEMORRHOIDS

SIMPLE—

Treatment: 1. No treatment, except refer patient to a physician when available.

ASSOCIATED WITH BLEEDING—

Treatment: Mild Bleeding.

1. No treatment, except refer patient to a physician when available.

Treatment: Profuse Bleeding.

1. Bed rest.
2. Apply a pressure dressing to rectum with T binder.
3. Mineral oil ounces 2 (30 cc.) by mouth nightly.
4. Refer to a physician when available.

ASSOCIATED WITH PAIN—Examination will usually reveal a hard bluish-red mass (thrombosed hemorrhoid) or partial prolapse of the rectal mucosa with protruding hemorrhoids.

Treatment: 1. Apply benzocaine ointment (anesthetic hemorrhoid ointment). If this is not available apply boric acid ointment.

2. Gently replace prolapsed rectal mucosa and hemorrhoid if this condition is present.

3. Mineral oil ounces 2 (30 cc.) by mouth nightly.

4. Refer to a physician when available.

MALE GENITALIA

URETHRAL DISCHARGE—A profuse urethral discharge, in a patient with a history of recent exposure, should be treated as gonorrhea. A slight watery urethral discharge in a patient who has never had gonorrhea is probably due to some irritant other than the gonococcus.

Treatment: 1. Isolate patient in such a manner as to prevent contamination of other persons as well as other parts of his own body (particularly the eyes) with the urethral discharge.

2. Instruct patient to maintain a routine of strict cleanliness. Genitalia should be washed thoroughly each day and should be covered with a loose gauze dressing.

3. Insist on a fluid intake of at least two quarts (2000 cc.) daily.

4. Sulfadiazine grains 15 (1 gram), four times a day. Persist in this treatment for five days in spite of the subsidence of symptoms.

or

5. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours for a total of five injections.

6. Refer these patients, regardless of the outcome of treatment, to a physician for follow-up treatment.

Ulcers of the Penis—Should all be considered as syphilitic until laboratory procedures have proven this conclusion to be correct or incorrect.

Treatment: 1. Dress ulcer daily with boric acid ointment or apply a dry dressing after dusting the ulcer with sulfanilamide powder.

2. If the ulcer is large and there is considerable swelling, apply boric acid solution soaks for forty minutes, four times a day. Then apply sulfanilamide powder as above.

3. Refer to a physician as soon as one is available regardless of whether or not the ulcer has healed.

4. *Do not give penicillin.*

The lymph gland enlargement that is commonly associated with penile ulcers needs no special treatment unless these glands become abscessed.

Treatment: 1. Partial bed rest.

2. Give sulfadiazine grains 60 (4 grams), initial dose, and follow with grains 15 (1 gram) four times a day.

3. Give at least 3 quarts (3,000 cc.) of fluids daily.

4. *Do not give penicillin.*

Swelling of the Penis—An infection of the inner portion of the foreskin (prepuce) of individuals whose foreskin can only be retracted with difficulty, often results in a marked swelling of the penis. This condition is a common complication of gonorrhea but may be the result of uncleanliness.

Treatment: 1. Warm boric acid solution soaks for forty-five minutes, four times a day.

2. Irrigate the space enclosed by the foreskin (preputial cavity) with boric acid solution at the completion of the warm soak.

3. Treat gonorrhea with sulfadiazine if the disease is present.

4. *Do not give penicillin.*

5: Refer to a physician when available.

TUMORS OF THE PENIS—Small wart-like growths on the penis are not uncommon. These growths are commonly called venereal warts but are not venereal in origin. They are usually associated with poor local hygiene.

Treatment: 1. Soap and water cleansing of the penis daily. Sprinkle sulfanilamide powder on any ulcerated area after this washing.

2. Refer to a physician when available.

SWELLINGS IN THE SCROTUM

PAINFUL—Painful hard swellings in the scrotum are usually due to an epididymitis, the most frequent cause of which is gonorrhea.

Treatment: 1. Same as Urethral Discharge.

2. Suspend painful scrotal contents in a suspensory bandage.

3. Modified bed rest.

4. Refer to a physician when available.

NON-PAINFUL—Hydroceles and hernias may cause either hard or soft swellings in the scrotum. Other tumors will occasionally be found.

Treatment: 1. Apply suspensory bandage, if this provides comfort.

2. Refer to a physician when available.

BACK

PAIN IN THE BACK

ACUTE—The sudden onset of pain in the back which does not follow an injury is not unusual. This pain may vary in intensity from a very minor pain to one of considerable severity.

Treatment: 1. Rub on liniment.

2. Apply dry heat.

3. Strap back with adhesive tape.

4. Aspirin grains 10 (0.6 gram), repeat at four hour intervals as needed.

5. Have the patient lie on his back at bed rest on a hard bed if the pain is severe and not relieved by the treatment outlined above.

CHRONIC OR RECURRENT PAIN—Is usually a symptom of arthritis and may vary in severity from a non-disabling pain to a completely disabling condition.

Treatment: 1. Same as that outlined for Acute.

Infections Near the Lower End of the Spine—Infections that are found at the base of the spine, in the region of the sacrum, need to be differentiated from other skin infections. An abscess, sinus, or even a localized painful area in this region should be treated as a pilonidal cyst.

Treatment: 1. Keep area clean by washing with soap and water.

2. If the problem is one of drainage from one or more openings, apply a dry dressing after sprinkling the cleaned surface with sulfanilamide powder.

3. Apply warm compresses for forty minutes twice daily if an abscess is developing.

4. Do not incise infections in this region.

5. Refer to a physician when available.

SKIN

A definite etiological diagnosis of all skin diseases is theoretically desirable. This goal is not possible, under the most favorable conditions, and will be rarely achieved by the Hospital Corpsman.

A skin disease may be due to an infection or irritating agent acting directly upon the skin. It may also be the result of nervousness, a toxic manifestation of a drug, the result of an allergy, or a manifestation of systemic diseases, (syphilis, measles, or many others).

The Hospital Corpsman's treatment of these conditions should be directed toward the relief of pain, swelling, tenderness, itching and the prevention of complicating infections. He must treat the skin gently at all times, and above all else, never "add insult to injury" by applying strong antiseptics or irritants. The use of the simple measures that follow will reward the Hospital Corpsman by promoting a marked degree of comfort in his patients.

PURULENT SKIN CONDITIONS

Localized to a Single Area—Single skin infections may vary in severity from a small hair root infection to a severe spreading infection of the skin and subcutaneous tissues (cellulitis) with evidence of general infection. This group includes solitary pimples, boils, carbuncles, and cellulitis. It should be remembered that a skin infection that begins as one of the milder infections may later get out of control and become one of the more serious types.

Treatment: Mild.

1. Wash with soap and water.

2. Dress with sulfathiazol ointment, or apply a mild skin antiseptic followed by a boric ointment dressing.

Treatment: Moderately Severe.

1. Clean the area with soap and water.

2. Apply warm boric acid compresses for forty minutes, twice daily, until the infection drains spontaneously.

3. Protect the infected area against injury with a boric acid ointment dressing following the wet dressing.

4. After drainage, dress daily with boric acid ointment after a thorough soap and water cleansing of the area.

Treatment: Severe.

1. Continuous warm boric acid compresses to the infected region.

2. Elevate and restrict the activity of the infected region by splints or slings.

If systemic symptoms (fever, feeling of illness, red streaks, and enlarged tender lymph glands) are present, continue with the above and in addition give:

1. Bed rest.

2. Sulfadiazine initial dose grains 60 (4 grams), then grains 15 (1 gram) at four hour intervals until the temperature is normal.

or

3. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

MULTIPLE AREAS—Multiple skin infections usually result from the spread of an infection from a single area. This is one of the reasons for the thorough soap and water cleansing of the skin surrounding boils and carbuncles. Secondary boils or carbuncles are treated in the same manner as the primary lesion. The most common types of multiple skin infections are: (1) IMPETIGO which is characterized by small painful blisters or blebs that quickly become purulent, open and covered with yellow crusts. (2) INFECTED ACNE characterized by the presence of numerous black heads, pimples, and multiple skin infections which vary from a small painful pimple to a large boil. (3) FOLLICULITIS which is characterized by multiple infections of the hair roots. This condition is most commonly seen among the engine crew and may be referred to as "machine oil dermatitis".

Treatment: 1. Thorough cleansing of the skin of the entire body with soap and water daily. Wash off all dry crusts, particularly those covering pus pockets.

2. Apply sulfathiozol crystals or sulfanilamide powder to all infected areas.

or

3. Irrigate with penicillin solution 500 units in 1 cc. of normal saline four times a day. Collect the overflow solution on a sterile gauze pad which should then be used as a covering until the next treatment.

4. Cover the draining lesions with gauze dressings.

5. Be sure that clothing which has been contaminated with pus is not worn until it has been thoroughly cleaned.

Note—If itching is present beyond a mild degree and the skin lesions are small papules mixed with pustules and are localized on the hands, shoulders, chest, lower abdomen, and genitalia, the condition is probably scabies.

LOCALIZED SKIN ERUPTIONS

FACE—Skin lesions that are confined to the face and are not associated with general symptoms should not be treated until the patient is seen by a physician. Itching may be relieved in part by the use of calamine lotion.

Ulcerated lesions may be dressed with boric acid ointment dressing. If there is fever, enlarged lymph glands, or other evidence of infection, give the treatment prescribed for cellulitis. See Purulent Skin Conditions.

HANDS—Small blisters combined with scaly lesions, or small blisters followed by scaling, are quite common on the hands. This condition may be a manifestation of allergy, local skin irritation, or nervousness.

Treatment: 1. If the condition is severe, apply continuous cold boric acid solution compresses. If it is mild or moderately severe, apply boric acid solution soaks, twice daily, for forty minutes. As the skin dries, it may crack (fissure) in which case, a thin gauze dressing may be applied over very thin application of boric acid ointment. As a general rule, ointments should not be used in the treatment of weeping skin lesions.

2. Phenobarbital grain ¼ (0.015 gram) given four times daily if excessive nervousness is present.

FEET—Skin lesions on the feet and between the toes, characterized by scaling, small blisters, and itching, are usually fungus infections (athlete's foot).

Treatment: If there is swelling, redness, or exudation of serum associated with the skin lesions:

1. Apply boric acid solution soaks for forty minutes, twice daily.

2. Dry skin and apply a thin gauze dressing over a thin application of boric acid ointment.

3. Spread toes apart with gauze pads.

4. Have patient wear open toed slippers or shoes, if possible.

5. Strong skin antiseptics and ointments should not be used.

When the condition improves or if it was mild originally:

1. Apply a thin coating of ½ strength Whitfield's Ointment, and cover with a gauze dressing. Apply just enough ointment to make the skin shiny—no more. Change dressing daily and stop treatment after seven days. The treatment may be resumed after a five-day, non-treatment period, if necessary.

Ulcers and discoloration of the skin are often evidence of serious disease, and usually indicate poor circulation of blood.

Treatment: 1. Apply protective dressing of gauze over sulfanilamide powder.

2. It may be necessary to place the patient at partial bed rest.

3. Refer to a physician when available.

Corns are localized thicknesses of the skin and are caused by pressure, usually from poorly fitting shoes.

Treatment: 1. Apply a ring type of protective dressing.

2. The upper layers of the corn may be trimmed if it is done carefully and with sterile technique.

THIGHS—Skin lesions on the inner surfaces of the thighs and crotch are quite common. These lesions may be painful, itchy, or asymptomatic. They are usually caused by a fungus.

Treatment: 1. If the skin is painful and irritated, apply boric acid solution compresses, twice daily, for forty minutes. Then apply calamine lotion.

2. When the inflammation has partially subsided, apply half strength Whitfield's Ointment daily. Apply only enough ointment to make the skin shiny. Stop treatment after seven days.

HAIRY AREAS—Itching in the absence of skin lesions, except for scratch marks, particularly in hairy regions, is suggestive of lice. A careful search of these regions will usually reveal small moving insects and small gray eggs which are firmly cemented to the hairs.

Treatment: 1. Dust the affected area with D.D.T. Personal Insecticide Powder daily, for three successive days.

2. If body lice are suspected, dust the clothes worn next to the body, as well as the body.

3. Daily soap and water baths and change of underwear.

GENERALIZED SKIN RASHES WITHOUT SYSTEMIC SYMPTOMS

HIVES—Transient, very itchy, raised red spots often with white centers. his condition is the result of sensitivity to some substance, usually a food eaten a few hours before the eruption.

Treatment: 1. Magnesium sulfate, 2 tablespoonfuls as a cathartic.

2. Calamine lotion to skin lesions.

3. Try to determine the causative agent in order to prevent a recurrence. All cases of hives do not disappear in a few days as is the typical case. These patients should be referred to a physician when available.

PAPULAR AND MACULAR ERUPTIONS—Eruption of small raised or flat spots are not uncommon. These skin lesions will vary in color from pale pink to dark red and violet. The causes of these eruptions are numerous and vary from simple skin irritations as in heat rash, to skin manifestations of internal diseases. Itching may be absent, slight, or intense. Treatment is usually directed toward the relief of the itching except for those cases in which the cause can be discovered. When itching is mild or absent, suspect a mild case of one of the infectious diseases. Syphilis is also a possibility. The patient must be examined for other evidences of these conditions. When itching is intense, particularly when the skin is warm, and there are occasional pustules and burrows mixed with the papular skin lesions, suspect scabies.

Treatment: 1. Magnesium sulfate, 2 tablespoonfuls as a cathartic.

2. Calamine lotion to the skin lesions twice daily.

3. Starch or oatmeal baths may be given twice daily, if the calamine lotion proves ineffective.

4. Phenobarbital grain 1/4 (0.015 gram) repeated as often as four times a day for the relief of anxiety and restlessness.

5. Refer to a physician when available.

If an infectious disease is suspected:

1. Isolate the patient in the Sick Bay.

2. Treat skin as above if itching is present although no treatment is ordinarily required.

If scabies is suspected:

1. Cover the entire body with soft soap and work it into a lather with warm water. Scrub with soft nail brush, giving special attention to the groins, between the thighs, abdomen, buttocks, armpits, wrists, and between the fingers and toes.

2. Give a warm bath and at the same time scrub affected areas for ten minutes.

3. Apply 25% benzyl benzoate emulsion with a stiff shaving brush while the body is still wet. Continue to brush for at least five minutes and allow the emulsion to dry on the body.

4. Put on the clothing worn before the treatment.

5. Between twelve and twenty-four hours later, repeat steps 2 and 3. Have the patient put on clean clothing.

6. Discarded clothing, bed linen and towels should be boiled or dry cleaned.

SCALY SPOTS—Scaling skin lesions are evidence of chronic or healing skin conditions. Treatment can usually be delayed until a physician is available. If itching is present, apply calamine lotion. Sunlight is of value in the treatment of some of these cases but care should be taken to prevent sunburn.

WEEPING SKIN LESIONS—Skin lesions that are open and exude serum are evidence of recent and severe skin injury. These areas must be treated with great gentleness for irritants of any kind will cause further skin damage. Itching may or may not be present.

Treatment: 1. Bed rest will usually be necessary in severe cases.

2. Magnesium sulfate, 2 tablespoonfuls as a cathartic.

3. Light bland diet. If there is a suspicion that the patient is sensitive to certain foods, exclude them from his diet.

4. Phenobarbital, grain 1/4 (0.015 gram) if itching is intense or if the patient is restless. This dose may be given four times a day.

5. Apply boric acid solution compresses continuously to the skin lesions. As they become dry, apply calamine lotion twice daily instead of the boric acid solution compresses.

GENERALIZED SKIN RASHES WITH SYSTEMIC SYMPTOMS

Generalized skin rashes that follow immediately, precede, or are associated with fever, a feeling of illness, headache, stiff neck, and other signs of a systemic infection, should be considered as symptoms of systemic diseases and not skin diseases. The recognition of these diseases depends upon experience and judgment that is only acquired by long experience and training. Since the Hospital Corpsman may only be able to suspect that his patient has a specific disease, it is sufficient that he recognize the disease as infectious and treat it accordingly. The accompanying chart will be of some value in differentiating these conditions. The descriptions are of the typical case and do not take into consideration the atypical cases and the day to day variations of the typical cases.

Treatment: 1. Isolate in the Sick Bay.

2. Bed rest or modified bed rest depending upon the severity of the illness.

3. Diet will depend upon the severity of the illness. If the patient is not too ill and wishes it, he may eat a normal diet. Be sure to maintain an adequate intake of fluids, 3 quarts (3000 cc.) daily.

4. Relieve headache and high fever by aspirin grains 10 (0.6 gram). This dose may be repeated at four hour intervals if needed.

5. Control restlessness by phenobarbital grains 1½ (0.09 gram) at six hour intervals.

6. Relieve skin itching by applications of calamine lotion twice daily.

7. Keep the patient's body and bed clean.

8. If meningitis is suspected, give sulfadiazine initial dose grains 60 (4 grams), subsequent doses grains 15 (1 gram) every four hours, and give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

9. Be alert to detect other cases of disease among the ship's crew.

10. Do not release the patient from isolation until all symptoms of illness have disappeared.

11. Upon arrival, report the illness to the Port Medical Authorities and prevent contact with shore until authorized.

12. Refer the patient to a physician when available.

GENERALIZED SKIN RASHES WITH SYSTEMIC SYMPTOMS

Disease or condition	Length of illness	Temperature characteristics	Skin rashes	Prominent symptoms	Treatment requirements
Measles	10 to 14 days	Moderate to high	Clusters of red spots (macules) which increase in number, and group together to form irregular blotches. Rash first appears on the face and spreads down the body.	A three to five day period of symptoms resembling a cold before the eruption.	1. Isolation. 2. Watch for complications.
Scarlet fever	3 weeks	High	Multiple small scarlet spots (macules) which coalesce and produce a diffuse scarlatinal rash which blanches with pressure. Rash usually starts on the neck and chest and spreads to the extremities. Desquamation, peeling of the skin, is prominent during recovery.	Sore throat, heavily coated tongue in early stages, later "strawberry tongue".	1. Isolation. 2. Watch for complications.
Chicken Pox (Varicella)	10 to 14 days	Often high in adults	Crops of vesicles (blisters) which become pustules, later crusts. Lesions appear in all stages and are not dimpled. They are most abundant on the inner and most protected surfaces of the body.	Headache, generalized aching, loss of appetite. Adults are usually very sick.	1. Isolation. 2. Prevent secondary infection of skin lesions.
Smallpox (Variola)	21 to 40 days	Usually high but may be mild.	Papules which become many-pocketed (multilocular) vesicles often dimpled, later pustules and finally crusts. The lesions are in the same stage. They are most numerous on the outer and most exposed surfaces of the body.	*No history of vaccination*, headache, generalized aching, particularly back ache, and prostration.	1. Isolation. 2. Vaccinate crew.
Typhoid Fever	6 to 10 weeks	High	Faint rose colored spots on the abdomen (usually difficult to see).	Continued high fever with gastro-intestinal symptoms.	1. Isolation.

Typhus Fever	10 to 14 days	High	Round or oval pale pink spots on abdomen and back. Rash may become generalized, deep red, and at times black (purpuric).	Abrupt onset often with chill, prostration, severe headache and muscular aches, mental confusion and at times delirium.	If patient was a recent resident where louse-borne typhus was prevalent, delouse the crew.
Meningitis	Depends upon the administration of specific treatment.	High	Eruption of small dark red spots which tend to become confluent and black. Eruption first appears on the extremities, and sites of pressure. It may be absent or very scarce.	Early symptoms similar to a "cold", later headache and stiff neck.	1. Sulfadiazine. 2. Isolation.
Syphilis, Secondary	Weeks to months	Slight	Most common type is a papulo-macular rash generally seen on the abdomen, sides of trunk, arms, palms and soles. Other types of eruptions (papular, pustular, and vesicular) also occur.	*A chancre or history of one*, headache, sore throat, generalized aching (all mild).	1. Give no anti-syphilitic treatment. 2. Prevent spread of infection to others.
Drug rashes	Depends upon the time of withdrawal of the causative drug.	Usually normal but is elevated when caused by the sulfonamides.	All types of skin lesions; the eruption is roughly symmetrical and widely distributed.	History of the use of a drug; particularly arsenicals, barbiturates, bromides, iodides, and the sulfonamides.	1. Stop the drug.

GENERAL SYMPTOMS

APPETITE, DECREASE OF—A decreased appetite which exists for a short period of time is usually present in many acute and chronic diseases. It may also be the result of an emotional disturbance.

Treatment: 1. Refer patient to a physician if this condition persists beyond a short period of time.

APPETITE, INCREASE OF—Excess appetite, particularly when it is associated with loss of weight, suggests a serious condition. These symptoms are particularly prominent in certain phases of diabetes mellitus and exophthalmic goiter.

Treatment: 1. Supplement diet by between-meal feedings.

2. Refer to a physician when available.

CHILLS—A chill is frequently present as the initial symptom of many bacterial infections, especially those associated with abscess formation in the internal organs. The presence of pathogenic bacteria in the bloodstream (bacteriemia) is the most frequent cause of chills. Chills are usually followed by a rapid rise in temperature.

Treatment: 1. Absolute bed rest.

2. Light diet.

3. Fluid intake of at least 3 quarts (3000 cc.) daily.

4. Sulfadiazine grains 60 (4 grams), initial dose, then grains 15 (1 gram) at four hour intervals. If the patient does not improve within two days, or if it appears undesirable to wait this length of time, give penicillin in addition to sulfadiazine.

or

5. Give penicillin 20,000 units in 4 cc. of normal saline intramuscularly, every three hours. Continue treatment until symptoms have subsided, or stop treatment after three days trial if there has been no noticeable improvement.

If the individual has recently been in an area where malaria is prevalent and develops fever preceded by a chill, consider the patient as having malaria.

Treatment: 1. Quinacrine grains 3 at four-hour intervals during the first twenty-four hours, omitting the early morning dose; total 15 grains.

2. Quinacrine grains 1½ three times a day for six more days; total 27 grains.

3. If the patient is unable to tolerate quinacrine or if this drug is unavailable, give quinine sulfate, grains 15, three times a day for two days; then grains 10, three times a day for an additional five days.

CONSTIPATION, ACUTE—Often associated with acute infectious diseases and other conditions which limit a person's food intake and activities.

The usual cause is a change in eating or exercise habits. It may also be a symptom of a serious abdominal illness.

Treatment: 1. Mild cathartic such as cascara sagrada tablets, or mineral oil ounce 1 (30 cc.) unless contraindicated by other symptoms.

CONSTIPATION, CHRONIC—Is usually a functional condition directly related to faulty bowel habits and is extremely common among seamen. The Hospital Corpsman should encourage individuals with this condition to seek medical advice and discourage self treatment. Many of these individuals will have normal bowel movements if they will delay taking a cathartic for a sufficient length of time. The Hospital Corpsman should discourage the routine use of cathartics, but will of necessity have to dispense one occasionally.

CONVULSIONS—May be caused by many conditions, among which are epilepsy, hysteria, diseases of the blood vessels of the brain, and brain tumors. The Hospital Corpsman should appreciate that a convulsion is a sign of a serious condition, and should place the patient under the treatment of a physician as soon as practical. Epilepsy will probably be the most common cause of convulsions among the Hospital Corpsman's patients. This condition is characterized by recurrent convulsions sometimes preceded by abnormal visual sensations; the onset is sudden, often associated with a loud cry. The patient falls unconscious, the pupils are dilated, and there is cyanosis and often involuntary urination and defecation. Following the convulsion, the unconscious state gradually changes to a normal exhausted sleep.

Treatment: 1. Protect the patient against injury during attack.

2. Observe and record carefully the characteristics of the convulsion.

3. Phenobarbital grains 1½ (0.09 gram), three times daily.

4. Refer to a physician when available.

CRAMPS, MUSCULAR—Cramps are common after exertion, particularly in an individual who was subjected to excessive heat.

Treatment: 1. Salt tablets, 2 every four hours until cramps are relieved.

2. Prevent heat cramps by supplying crew with salt tablets when working in excessive heat.

DEATH, SUDDEN—Among its causes are severe trauma, heart disease, brain hemorrhage, and ruptured aortic aneurysm.

DELIRIUM—Is commonly found among patients suffering from high fever, in acute toxic states, and persons suffering from mental disorders.

Treatment: 1. Watch patient carefully to prevent self injury.

2. Physical restraint if required.

3. Treat other symptoms as directed elsewhere.

4. Seek the advice of a physician as soon as possible.

DIARRHEA—Will be one of the most common conditions to confront the Hospital Corpsman. Diarrhea may be caused by a mild emotional disturbance or it may be associated with dangerous diseases such as typhoid fever. The best clues to the severity of the underlying cause will be the length of time the diarrhea persists; its severity; and the presence or absence of other symptoms such as vomiting, fever, abdominal pain, bloody stools, and the persistence as well as the severity of these additional symptoms. Because of the possibility of a diarrhea being one of the first symptoms of an infectious disease, the feces and articles contaminated with feces should always be disinfected.

Treatment: First 24 hours.

1. Treat other symptoms.

2. Soap suds enema.

3. Bismuth subcarbonate, 1 teaspoonful in a half glass of water every two hours or paregoric, 2 teaspoonfuls (8 cc.) every two hours until diarrhea ceases.

If diarrhea persists for over 48 hours and is associated with fever and other evidence of systemic disease.

1. Bed rest.

2. Isolate patient so that his stools and urine or articles soiled by urine and feces do not come into contact with the crew.

3. Sulfadiazine, grains 60 (4 grams) initial dose then grains 15 (1 gram) at four hour intervals.

4. Give 1 quart (1000 cc.) of normal saline subcutaneously (hypodermoclysis) daily if patient is unable to retain fluids by mouth.

5. Diet should be limited to soft foods.

6. Refer to a physician as quickly as possible.

INCOORDINATION—Or lack of normal control of the muscles in walking or performing other activities, is associated with numerous diseases of the nervous system.

Treatment: 1. Protect patient against injury.

2. Refer to physician when available.

ACUTE DIARRHEA

Disease	Usual length of illness	Character of Diarrhea	Other prominent symptoms	Treatment requirements
Acute Gastro-Enteritis	2 to 5 days	Depends upon the degree and site of bowel involvement. Usually the stools are "formed" at first and later become liquid.	Onset abrupt with nausea, vomiting, and cramping pains in the abdomen. Fever is slight or absent.	Anti-diarrheal drugs after 12 to 24 hours.
Food Poisoning	6 to 24 hours	No diarrhea in very mild cases. Usually there are a few diarrheal stools that are forceful in character.	Sudden onset of nausea and vomiting, with marked weakness and abdominal cramps. Several persons are affected. Onset within a few hours after eating.	Find the cause and prevent future cases.
Bacillary Dysentery	5 to 14 days	Frequent small stools containing mucus and blood, associated with straining and frequent desire to move the bowels.	Sudden onset with griping abdominal pains and cramps. Fever over 38°C (100.3°F), loss of appetite, headache and general malaise.	Sulfadiazine; adequate fluid intake; disinfect stools.
Typhoid Fever	6 to 8 weeks	Often constipation or normal stools during first week of illness, then frequent small, watery, offensive stools.	High continuous fever 39°C to 40.5°C (102.2°F to 105°F) with symptoms suggestive of bronchitis and headache, loss of appetite, prostration and abdominal pain.	Isolation. Excellent nursing care, soft diet with frequent feedings.
Cholera	10 to 14 days	Violent purging. Stools quickly become greyish white (rice-water stools).	Usually epidemic and tropical, onset abrupt with vomiting, collapse, sub-normal temperature, muscular cramps and rapid dehydration. Death is common.	Isolation. Maintain body heat; subcutaneous and intravenous fluids.
Amebic Dysentery	A few weeks but may become chronic or recurrent.	Diarrhea is mild at first. Bowel movements later become very frequent and contain much blood, pus and mucus.	Moderate abdominal discomfort. The usual history is one of intermittent attacks of diarrhea.	Disinfect stools; anti-diarrheal drugs.

INDIGESTION—This term is intended to include slight degrees of abdominal distention (gas on the stomach) and mild attacks of hyperacidity (sour stomach and heartburn). These symptoms usually appear after over-eating, over-drinking and eating or drinking during times of emotional stress or excitement. They also follow the consumption of certain foods by persons who cannot tolerate those foods.

Treatment: 1. Sodium bicarbonate, 1 teaspoonful in a glass of water. This dose may be repeated as needed.

2. If attacks are frequent, suspect the presence of a more serious condition and refer to a physician when available.

JAUNDICE—Will be recognized as a yellowish discoloration of the skin and mucous membranes. It is usually first visible in the eyes. It is caused by destruction of blood, injury to the liver cells with suppression of liver function, or obstruction of the bile ducts. It is usually indicative of serious disease. The most common cause of jaundice in the Hospital Corpsman's experience will be that which is commonly described as catarrhal jaundice. This condition is characterized by gastro-intestinal upset, slight fever, mild to severe yellowish discoloration of the skin, bile pigment in the urine, and clay-colored stools. The yellowish discoloration of the skin that frequently follows the use of quinacrine (atabrine) is not jaundice. This condition is caused by the depositing of a yellow dye in skin.

Treatment: 1. Diet rich in proteins and especially sugar; free of fats. Encourage these patients to eat sugar or sugar candy at frequent intervals throughout the day.

2. Bed rest, if this is required.

3. Refer to a physician when available.

SENSATIONS—ABNORMALITIES OF—The inability to detect sensations or the abnormal interpretation of sensations is characteristic of several, serious nervous disorders.

Treatment: 1. Protect patient against injury.

2. Refer to a physician when available.

SHOCK, AND COLLAPSE—Differ only in degree of severity and are the result of a sudden suppression of vital activities. They usually follow injury or severe illness. The characteristic signs are pallor, cold sweat, dilated pupils, weak rapid pulse, shallow breathing, mental apathy and sub-normal temperature; later there may be vomiting, a great restlessness and excitement, and even delirium. The conditions that are prone to produce shock, particularly shock of a non-traumatic nature, are extremely serious conditions, and are beyond the ability of the Hospital Corpsman to treat successfully.

Treatment: 1. Morphine sulfate grain 1/4 (0.015 gram) for relief of pain.

2. Bed rest in a supine position, cover patient with blankets to maintain body heat.

3. Treat other symptoms as they arise.

4. Seek the advice of a physician as quickly as possible and be prepared for the death of many of these patients.

TEMPERATURE, ELEVATION OF—The elevation of body temperature above normal, except for slight temperature elevation for short periods of time, should be considered as evidence of illness. Treatment of the patient will depend upon co-existing symptoms. In some instances the elevation of temperature will be the only symptom present. Patients of this type should be treated by limiting their physical activities, and by referring them to a physician when available.

UNCONSCIOUSNESS—The causes of unconsciousness are many and dangerous. Several of these conditions have been discussed under the headings of Paralysis, Convulsions, and Collapse and Shock. Unconsciousness may also appear as a terminal stage in many diseases, but is an early or prominent feature in others. These diseases include cerebral (brain) hemorrhage, uremia (toxic state caused by inadequate kidney function), diabetes mellitus, actue alcoholism, poisoning, over-dose of insulin (hypoglycemia), epilepsy and meningitis. While the Hospital Corpsman will be unable to make an accurate diagnosis in some cases, he can apply certain general principles of treatments.

Treatment: 1. Bed rest. Watch the patient carefully and restrain if necessary. Periods of excitement and convulsions may occur.

2. Do not attempt to have the patient swallow food or fluids. If fluids suitable for intravenous or subcutaneous injections are unavailable, give liquids by gavage.

3. Give 1 quart (1,000 cc.) 5% glucose solution intravenously, or normal saline subcutaneously, twice daily.

4. Keep the patient and his bed clean; these patients are unable to control their bowels and urine (incontinent). Special attention should be given to the cleanliness of the mouth. Bed sores (decubitus ulcers) should be guarded against. Change the position of the patient frequently to prevent hypostatic pneumonia.

5. Take a thorough history in an effort to determine the cause of the unconsciousness.

6. If poisoning or acute alcoholism is suspected, empty the stomach.

7. If an overdose of insulin is suspected, give a glass of orange juice or other sweet drink by mouth, provided the patient can swallow. If

he is unable to swallow, give 1 quart (1,000 cc.) of 5% glucose solution intravenously.

8. If meningitis or some other infection is suspected, give 20,000 units of penicillin intramuscularly every three hours. Do not persist with this treatment after twelve hours if it is unsuccessful.

9. Be prepared for the death of some of these patients.

10. Obtain the advice of a physician as soon as possible.

URINATION, LACK OF CONTROL—Inability to control the flow of urine is associated with serious diseases of the nervous system. In younger people it is frequently the result of emotional imbalance.

Treatment: 1. Refer to physician when available.

URINATION, PAINFUL OR DIFFICULT—Common causes are infection of urethra (urethritis), enlargement (hypertrophy) of the prostate gland, stricture of urethra, infections of the bladder (cystitis), and bladder and urethral stones (calculi).

Treatment: 1. Consider the condition a symptom of an infection of the bladder or urethra. This infection may be associated with an enlarged prostate gland, urethral stricture, or urinary stone (calculus).

2. Sulfadiazine grains 15 (1 gram), four times a day.

3. Fluid intake of 3 quarts (3,000 cc.) daily.

4. Refer to physician when available.

URINE, BLOOD IN—Blood in the urine (hematuria) indicates a serious condition and deserves the attention of a trained physician as quickly as one is available.

Caution: Highly colored reddish urine does not necessarily contain blood.

URINE, INCREASE IN AMOUNT OF—Commonly associated with diabetes mellitus, diabetes insipidus and serious kidney diseases. Patients should be referred to a physician as soon as one is available.

URINE, RETENTION OF—The complete retention of urine is a comparatively rare condition and is caused by several conditions which the Hospital Corpsman will be unable to treat. The retention itself, however, will have to be controlled if the patient is to reach a physician alive.

Treatment: 1. Have patient attempt to urinate while sitting in a tub of warm water.

2. If the above is not successful, attempts to catheterize the patient should be made.

3. Seek the advice of a physician as quickly as possible.

VOMITING—Is frequently present at the onset of many of the infectious diseases. It is a common symptom of diseases of the gastro-intestinal tract. It is frequently present during emotional disturbances, and

aboard ship it is most commonly seen in sea sickness. The treatment of a case of vomiting depends upon the cause of the vomiting, although certain general principles are applicable to most cases.

Treatment: 1. Withhold food and water for at least one-half hour after the vomiting ceases.

2. Give small sips of water at ten minute intervals. If this fluid is retained, gradually increase the quantity of fluid intake.

3. Have patient lie quietly in bed.

Vomiting Accompanying Sea Sickness—There are very few sailors who have never been sea sick at some time during their career. The treatment of any case of sea sickness will depend upon the severity of the particular case.

Treatment: 1. Reassure the patient.

2. Whenever possible provide good ventilation.

3. Whenever possible keep the patient on duty even though his work is quite inefficient.

4. Give phenobarbital grain ¼ (0.015 gram), to the more severe cases. This dose may be repeated as often as four times a day.

5. If the patient continues to vomit in spite of the above treatment, and he is obviously becoming exhausted, it will be necessary to place him at bed rest. The treatment with phenobarbital as outlined above should be continued.

6. If vomiting continues in spite of bed rest, withhold fluids by mouth and give 1 quart (1000 cc.) of normal saline subcutaneously (hypodermoclysis), or give 1 quart (1000 cc.) of 5% glucose solution intravenously, twice daily.

Vomitus, Blood in (hematemesis)—The presence of blood in vomitus signifies a serious condition in the gastro-intestinal tract. The ultimate treatment of this condition will depend upon a thorough study of the case by a physician, and it is important that the Hospital Corpsman remember this fact, since all symptoms may disappear and the patient seem cured. Bloody vomitus is to be distinguished from blood coughed up from the lungs (hemoptysis). Blood that is vomited is usually clotted, mixed with particles of food, dark in color, and usually has the appearance of coffee grounds. Other symptoms of gastro-intestinal disease will usually be present and the stools will be tar-colored for several days after the hemorrhage.

Treatment: Mild.

1. Place patient in Sick Bay for observation and limit the physical activities.

2. Limit diet to soft foods and feed patient small meals eight times a day.

Treatment: Severe.

1. Absolute bed rest.

2. Ice bag to upper abdomen.

3. Limit diet to small quantities of liquids at frequent intervals.

4. Phenobarbital grains 1½ (0.09 gram) and, if necessary, morphine grain ¼ (0.015 gram) may be given to allay apprehension and to quiet the patient. Do not repeat the dose of morphine unless the hemorrhage recurrs.

5. If symptoms persist, seek the advice of a physician as quickly as possible and in any event, send the patient to a physician upon arrival in port.

WORMS—Patients will occasionally report that they have vomited a worm or that they noticed one in a bowel movement.

Treatment: 1. Reassure patient by informing him that he has undoubtedly had this condition for several months and that expert medical attention will be available long before his condition becomes serious.

2. Phenobarbital grain ¼ (0.015 gram) to aid with the above reassurance if necessary.

3. Obtain a sample of the worm and enter an accurate description of it in the Sick Bay log.

4. Refer to a physician when available.

Chapter V

TRAUMATIC CONDITIONS AND THEIR TREATMENT

Most of the conditions confronting the Hospital Corpsman will be due to injury. Most of these injuries will be minor or superficial in nature. However, the treatment of minor injuries has been repeatedly shown to pay dividends. The treatment of a mild injury with the protection to health and to the injured part afforded by this treatment, is often of more value than the treatment of a major condition which inevitably results in permanent disability. Modern industry, through elaborate systems of first aid, primarily designed to provide adequate care for the minor injury, has repeatedly shown that this treatment is not only economical for the company but likewise a morale builder among the employees. The prompt and successful treatment of a minor condition, while far less dramatic, is profoundly more satisfactory to the patient and to the individual giving the treatment, than is the treatment of the complicated condition that might result from the neglect of this minor injury. While major injuries are less frequent, the understanding of the problems they present, as well as the details of their care, is essential if the Hospital Corpsman is to properly perform his function.

The broad principles of treatment may be considered as those which apply to the site of injury and those which apply to the patient as a whole. These treatments may again be subdivided into those which are immediately required, and those which may be safely delayed until they can be administered under more satisfactory conditions. In general, local treatment involves the prevention of further damage to the wound, either through the removal of the force or substance causing the injury, or by proper protection of the site of injury to prevent further damage by contamination or improper movement. Another principle of local treatment is concerned with promoting rapid recovery, healing of the injured area and restoration of normal function. Under certain circumstances, it may be necessary to institute treatment for the protection of the patient as a whole, before all local treatments can be applied. Covering the wound to prevent contamination, and splinting the part to prevent further injury should not be unduly delayed. The principles applied in the treatment of the injured

individual as a whole are control of severe bleeding, treatment of shock if this condition is present or threatening, relief of pain, reassurance of the patient, prevention of systemic infections, provisions for rest, and maintainance of proper diet. The relief of pain is of considerable importance and the position in the scheme of treatment that it will occupy is obviously dependent upon the severity of the pain and the damage that this symptom is causing the patient. Reassurance of the patient should never be neglected although the competent and business-like manner in which the Hospital Corpsman treats the patient will do more to reassure him than will any other factor. The likelihood of a systemic infection following certain injuries is so great that for practical purposes it may be considered as already present and treatment should be instituted before symptoms appear. For this reason sulfadiazine by mouth, penicillin intramuscularly, tetanus toxoid, or tetanus antitoxin are administered following certain injuries.

WOUND HEALING

In order to understand wound healing it is essential that the Hospital Corpsman have an understanding of the constitution of tissue. All tissues of the body may be considered as composed of a supporting structure containing blood vessels, lymph vessels, nerves, and specialized cells. The type of tissue is determined by the specialized cell. Any injury to tissue involves the destruction or partial destruction of part of all elements that compose the tissue. Immediately following injury, there is bleeding into the injured area. The clot of fibrin resulting from this initial bleeding constitutes the first phase of tissue repair. This is followed in four or five days by the growth of connective tissue fibers into the fibrinous clot, and finally results in the formation of a scar. This second phase of tissue repair is ordinarily completed in about two weeks, and with most soft tissues is the final phase of repair. In certain specialized tissues, approximately three weeks after the injury, there is a growth of special cells into and replacing some of the connective tissue fibers. This may eventually result in a restoration of the injured tissue until it closely resembles its original form.

This healing process may be aided or hindered by several factors.

1. *The extent of tissue damage:* This includes the extent of the partial devitalization of tissue as well as the extent of actual tissue loss. It is obvious that a longer period of time is required to replace a large defect than a small one. The factor of partially devitalized tissue is less obvious. While it may take less time to revitalize partially devitalized tissue, some of the tissue dies and following death, acts as a foreign

body. It should also be remembered that partially devitalized tissue is more susceptible to infection and subsequent injury.

2. *The blood supply:* The ability of an injured tissue to provide for the growth of new blood vessels is fully as important as the vascularity of the tissue before injury. Equal in importance to the availability of blood channels is the quality of the blood; for from this blood must come the elements for new tissue construction. This factor is demonstrated by the more adequate and more rapid healing in younger individuals, as compared with individuals debilitated by age, disease, and malnutrition. It should also be remembered that obstruction to venous circulation through swelling, tight dressings, or the dependent position of the injury is a definite detriment to the flow of blood through the injured area and thus reduces the adequacy of the blood supply.

3. *Rest:* Rest of the injured area to prevent pulling or tissue tension, and thus a re-injury, is necessary to obtain normal healing. The relief of pain is likewise necessary to obtain complete rest of the injured part.

4. *Temperature:* In general, extremes of temperature are detrimental to wound healing since they cause further devitalization of tissues. A temperature a few degrees above the normal body temperature is considered as most conducive to wound healing.

5. *Foreign bodies:* Foreign bodies may originate in the wound or enter from the outside. Devitalized tissue and excessively large blood clots act as foreign bodies and must be either liquified and discharged to the outside, or absorbed, or encapsulated. The foreign particles introduced from the outside at the time of the injury or subsequent to it include dirt, bits of clothing, wood, stone, and metallic bodies. Their presence is harmful because they constitute a source of irritation, a potential focus of infection and must be either rejected or encapsulated. Chemicals, such as the sulfonamides and antiseptics that are painted on wounds, may also be considered as foreign bodies; however, the sulfonamides in small quantities are ordinarily considered as not being detrimental to wound healing. Any of the antiseptics, such as weak tincture of iodine and commercially prepared antiseptics, are mildly irritating and generally should not be used on fresh, traumatic wounds which are to be closed. The most important foreign bodies that may enter wounds are bacteria. These bodies may enter in large or small numbers. They may be of a type capable of producing severe infection (virulent bacteria) or relatively harmless (non-pathogenic bacteria). The non-pathogenic bacteria are relatively of little importance. A small number of the less virulent bacteria may be destroyed by the body defenses normally present in a healthy fresh wound.

CONTROL OF HEMORRHAGE

The body normally controls bleeding through the retraction of blood vessels and the clotting of blood. The retraction of blood vessels is due to the elasticity of their walls. This retraction causes a narrowing of the cut end of the blood vessel and also pulls this end from the cut surface of the wound, thus tending to bury the cut end of the blood vessel in surrounding normal tissue. The clotting of blood is accomplished through the transformation of substances within the blood stream, which are normally in a liquid state, into a solid mass of fibrin, through the interaction of substances released by the injured tissues. The blood clot, thus produced, acts as a mechanical barrier to the further flow of blood from the open end of the blood vessel. Most bleeding (hemorrhage) is controlled by the above mentioned mechanism without outside help. In so doing, however, more blood may be lost than will be the case if certain artificial measures of control are applied.

In order to aid these natural methods of hemorrhage control and thus prevent unnecessary loss of blood, some method of obstructing the flow of blood through the bleeding vessel is required. This obstruction is accomplished by either direct pressure over the site of hemorrhage, or by pressure at a convenient point on the major artery supplying the hemorrhaging area. Direct pressure over the bleeding area by means of a dressing (pressure dressing) is the method commonly used to control bleeding. The simplest form of pressure dressing is the common bandage applied to superficial wounds where a more prompt stoppage of bleeding is desired than will ordinarily occur spontaneously. Another common means used for the control of minor bleeding is to apply pressure directly over the area with the fingers, a sterile dressing being used first to cover the wound. This means of control is particularly suitable for hemorrhage in the mouth and lips. Bleeding from the nose can ordinarily be controlled by squeezing the nose between the thumb and forefinger. If the bleeding is in a partially enclosed space or recess, and it is desired to control this bleeding for a longer period of time than can be conveniently accomplished by digital pressure, packing the area with narrow strips of sterile gauze will provide an excellent means of control. Another adjunct for the control of minor hemorrhage is the simple elevation of the part.

Very severe bleeding may also be controlled by means of a pressure dressing. The best type of pressure dressing for this purpose is a large sterile pad which contains compressible material enclosed in a gauze covering. This dressing is applied directly over the source of hemorrhage

and is held tightly and securely in place by means of a wide elastic bandage. Other compressible materials, such as cotton or gauze, may be used to construct pressure dressings and may be secured to the bleeding areas with gauze or other types of bandage. Dressings of this type should be strategically placed about the ship so that they are immediately available in case of need. In instances where even more prompt control of hemorrhage is required and sterile dressings are not available, digital pressure may be applied directly to the wound. In these instances, the wound should be covered with a clean piece of cloth, if possible. Only in rare instances, will one be justified in omitting this precaution.

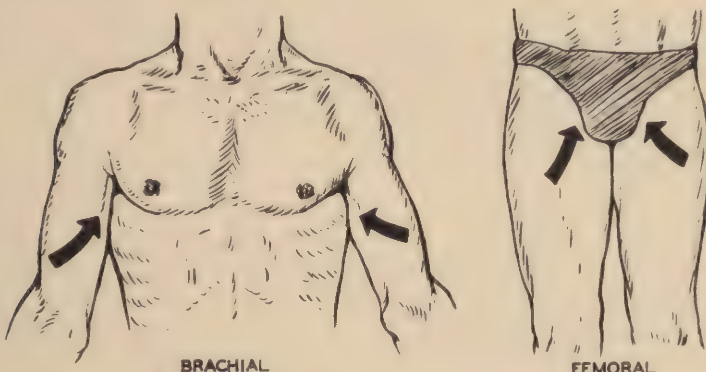


Figure 63. The most useful pressure points.

Pressure on the major artery supplying blood to the bleeding area can be accomplished, either through the use of pressure points or the tourniquet. Very little use will be found for either of these methods, except as temporary measures of control prior to the application of a large pressure dressing. With the exception of pressure over the brachial and femoral arteries, the other commonly described pressure points will be found to be of little or no value. The pulsation of these vessels can be palpated at the sites illustrated in Figure 63. Tourniquets will be found useful only for the control of hemorrhage of the extremities and should be applied at or near these points. In general, it may be said that the tourniquet is greatly over-used. Its use should be restricted to control very severe hemorrhage, such as may occur following a traumatic amputation. Common errors in its application are to apply it too loosely, which actually increases bleeding rather than decreasing it, or to apply it too tightly which may result in pressure upon nerve trunks and may cause paralysis. If a tourniquet is applied, it should never be concealed with clothing, blankets or other materials, and the

letters "T. K." should be conspicuously written on the patient's forehead. The tourniquet should be cautiously released every thirty minutes to see if bleeding has stopped and to flood the vascular bed to prevent the development of gangrene.

The permanent control of hemorrhage is usually accomplished by means of simple dressings or pressure dressings. An adjunct for this permanent control is the approximation of the wound edges by the application of adhesive plaster and sutures. If a tourniquet, direct digital pressure, or a pressure point was used to temporarily control hemorrhage from a large artery, permanent control may be accomplished by ligating (tying) the bleeding artery. Use of this method is not recommended for the Hospital Corpsman and, in most instances, he will be unable to find the bleeding vessels. Fortunately, the proper application of a pressure dressing will control practically all of these situations.

In addition to the treatment directed toward the control of bleeding, treatment of the patient for excessive loss of blood may be necessary. Ordinarily a pint of blood may be lost without producing symptoms. The loss of blood in excess of a pint may produce certain general symptoms, the severity of which will depend upon the quantity of blood lost. These symptoms are faintness, weakness, dizziness, perspiration, thirst, rapid pulse and respiration, shortness of breath, fainting and collapse. Treatment of these symptoms, after first controlling the bleeding, will depend upon their severity and the actual amount of blood lost. In most cases, it will be sufficient to place the patient in bed with his feet elevated, and maintain his body temperature by application of sufficiently warm bed clothes. The patient should be provided with water at frequent intervals but care should be exercised not to induce vomiting or discomfort through this means. In order to replace the fluid content of the blood as quickly as possible, in cases of severe hemorrhage, blood plasma should be administered immediately. One or two units (250 or 500 cc.) will ordinarily suffice.

CONTROL OF SHOCK

Minor injuries and minor surgical procedures such as the administration of vaccines and hypodermic injections are followed in some individuals by a feeling of lightheadedness, faintness, and pallor. At times, some of these individuals will faint. While these symptoms are very similar to those found in the early stages of true traumatic shock, the cause of these symptoms is transitory and, for this reason, the situation is not dangerous. Quick recovery will usually occur if the patient is allowed to lie down. It may be somewhat accelerated by the

inhalation of aromatic spirits of ammonia. When these symptoms occur following a severe injury, they are quite significant and demand prompt treatment. Burns covering an area equal to the anterior surface of the chest, crushing injuries which involve more than very small areas, and injuries to the chest and abdomen, as well as all other serious and painful injuries, will almost always be followed by shock. Unless shock is treated in its early stage, a more severe form will likely follow.

Severe shock is characterized by pallor, slight cyanosis, perspiration, a pulse which is rapid and difficult to feel, low blood pressure, rapid, shallow respirations, thirst, restlessness and later drowsiness, dullness, and finally collapse. These symptoms are essentially the result of an inadequate volume of circulating blood brought about by complex physiological changes. Because of this inadequate volume of blood, the entire circulation becomes inadequate and all vital functions are suppressed.

The prevention and treatment of shock is directed toward the correction of the condition that initiated it, toward the reduction of the demands of the body on the circulation, and re-establishment of an adequate circulation. Most shock can be prevented or brought under control if the conditions that commonly produce shock can be alleviated or removed soon enough. These conditions are pain, emotional disturbances, loss of blood, and damage to tissues. Pain should be controlled in all severe injuries by the prompt use of morphine and pain should not be produced by clumsy manipulation and careless handling. Splints and other protective devices should be immediately applied, if they are necessary, so that further tissue injury is prevented. All significant bleeding should be controlled, and the patient should be put to bed as quickly as possible. During these procedures, the patient should be reassured and comforted. The demands on the circulatory system may be reduced by placing the patient in bed with the lower part of his body elevated, and by retaining the body heat by means of adequate body covering. The circulation is improved by increasing the circulating blood volume. This may be accomplished by intravenous infusions of plasma, or if this substance is not available, by intravenous infusions of normal saline and 5% glucose. The success of this treatment will be indicated by an improvement of all symptoms. This improvement should be forthcoming within a few hours after treatment has been instituted. Initial improvement is followed at times by a relapse and this change should be anticipated and preventive treatment instituted at the first indication of a return to the shock state. The danger of shock persists, following certain injuries, for as long as forty-eight to seventy-two hours.

PREVENTION OF INFECTION

All open wounds must be regarded as potentially infected. It is almost impossible to conceive how any accidental wound could be effected without the simultaneous introduction of micro-organisms. The prevention of infection thus concerns itself, not only with preventing the entrance of micro-organisms, but also with eliminating those micro-organisms which entered the wound at the time of injury. As was stated before, entry of non-pathogenic organisms into a wound is generally of little significance, and the normal healthy wound is capable of defending itself against a small number of the mildly virulent micro-organisms. The entry of large numbers of mildly virulent micro-organisms or the entry of even a small number of highly virulent micro-organisms, will inevitably lead to an infection of the wound unless these micro-organisms can be eliminated. While every infection does not necessarily end in the loss of life, it may lead to a prolonged illness and to a serious loss of function of the injured part. It is for these reasons that even the most minor injury deserves prompt and adequate first aid treatment.

The micro-organisms that gain entry into a wound at the time of injury may be removed mechanically, or they may be rendered less harmful by certain chemicals. The mechanical cleansing of wounds is directed, not only toward the removal of as many of the bacteria as possible, but also toward the removal of all other foreign bodies that gained access to the wound at the time of injury, and to the removal of excessively large blood clots and devitalized tissues. It is obvious that all foreign bodies, including bacteria, cannot be completely removed and in order to give the wound every opportunity to protect itself against invasion, not only the number of entering micro-organisms should be reduced, but also all substances that may possibly promote bacterial growth should be removed. Profuse bleeding is a particularly potent aid toward the removal of small foreign particles, including bacteria, from wounds. Since the direction of the flow is from the inside out, it can never be simulated artificially. Thus bleeding serves a very useful purpose in the mechanical cleansing of a wound. Minor injuries need no further mechanical cleansing than is provided by hemorrhage. Larger wounds into which bits of clothing, gravel, dirt and other debris have been carried, will require thorough cleansing before a final dressing is applied. This is accomplished by first covering the wound itself with a sterile gauze dressing and then thoroughly cleaning the area adjacent to the wound with white soap and water. Grease and oil which may surround the wound can either be removed

by soap and water, or better by a detergent emulsion. The covering should then be removed from the wound and the wound thoroughly irrigated with sterile normal saline or sterile water. The flow of these solutions must be directed into the deepest crevices and cracks of the wound in order to remove all possible foreign bodies, loose dead tissue, and excessively large blood clots. A certain amount of bleeding may be initiated by this procedure, but this can be quickly controlled by direct pressure. Certain foreign bodies will have to be removed by lifting them from the wound with sterile forceps. Large foreign bodies that are deeply embedded, and whose removal will involve the destruction of a considerable amount of tissue, should be allowed to remain until the patient can be referred to a physician for treatment. After the completion of the mechanical cleansing of the wound, tags of tissue that are obviously devitalized should be removed with a sterile forceps and sterile scissors. Wounds that are extensive enough to require this treatment will ordinarily be associated with considerable pain, and the procedure outlined above is also apt to be quite painful. For these reasons, the use of morphine will probably be required.

It is an extremely common practice to apply antiseptic substances to the surface of wounds with the intention of killing the micro-organisms within the wound and thus render the wound sterile. This practice has lead to a wide-spread search for antiseptics which would be non-irritating and which would be able to kill micro-organisms that are found not only on the surface of the wound, but also within its depths. This search has been unsuccessful up to the present time. Most of the chemicals that are available for disinfecting purposes are somewhat irritating, particularly to partially devitalized tissues. All of the antiseptics are incapable of penetrating much beyond the surface and are thus unable to affect micro-organisms in the depths of the wound. The proper use of the sulfonamide preparations, recommended for topical application, does not adversely affect wound healing. These preparations are likewise unable to penetrate far beyond the immediate surface of the wound, but in this instance possible advantages outweigh the potential disadvantages, and a local application of these preparations is recommended for large, possibly contaminated, wounds. The sulfonamide powder or micro-crystals should be sprinkled lightly over the surface of the wound, since large quantities of these substances tend to cake and to act as foreign bodies. Large wounds with considerable loss of tissue, wounds in which deep structures such as muscles, tendons or bone are exposed, wounds in which there has been considerable crushing and thus a large amount of devitalized tissue, and wounds

which have been contaminated with a large quantity of foreign material, should be considered infected wounds even before any signs of infection are evident. In addition to the local treatment described above, the patient should receive treatment directed toward the control of these infections. This treatment consists of administering the sulfonamide drugs by mouth or penicillin intramuscularly, in addition to the usual supportive measures that are applied to any individual with a large injury. The administration of sulfonamide drugs and penicillin will greatly aid in the prevention of infection by the common pyogenic micro-organisms.

In order to prevent tetanus, additional measures must be instituted. Tetanus is another infection which is a possible complication from certain wounds. The micro-organism that causes this disease is commonly found in the intestinal canal of horses. In addition, these micro-organisms are spore-formers and are thus capable of surviving on the ground for long periods of time. The wide-spread use of horses, as well as the use of their excreta for fertilizer, has made almost all soil a potential reservoir of tetanus micro-organisms. These micro-organisms cannot live in an environment containing more than a slight amount of oxygen and thrive in partially devitalized and dead tissue. Thus wounds which penetrate to deep structures, or deep wounds associated with devitalized tissues are ideal locations for the development of tetanus. Wounds of this type, contaminated with soil, should always be considered as potentially infected with tetanus. Because of the severe consequences of tetanus, persons with wounds of this sort, even though these wounds have not been directly contaminated with soil, should receive tetanus prophylactic treatment. While the danger of developing tetanus aboard ship is probably less than would be the case if these wounds occurred elsewhere, the potential danger is still great enough to warrant the use of tetanus prophylaxis.

In addition to the danger of infection caused by the introduction of bacteria into the wound at the time of injury, there is a risk of contamination following the injury. Contamination of the wound may occur at the time of its first examination and first treatment, and it is imperative that the hands be scrupulously clean and that all instruments and dressings that come in contact with the wound, be sterile. Since bacteria may be carelessly introduced into the wound by coughing, loud talking, and sneezing, the Hospital Corpsman should refrain from these acts and direct his expired air away from the wound. A wound that has been carefully treated so that devitalized tissue, foreign

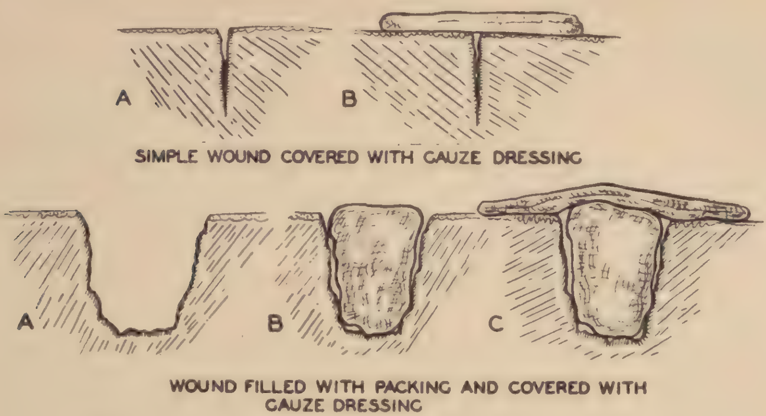


Figure 64. Sealing wounds against subsequent contamination.

bodies, and dangerous micro-organisms have been removed, will remain relatively sterile if properly sealed against later contamination. By approximating the edges with sutures or strips of adhesive tape and dressings, and by covering the wound with a sterile pad, a satisfactory sealing against later contamination is achieved. Wounds treated in this manner have the greatest chance for healing without infection. A wound in which it is not possible to remove all the devitalized tissue, all of the foreign bodies, or all of the dangerous micro-organisms, or wounds in which so much tissue has been lost that it is impossible to approximate their edges, should be allowed to heal from the bottom rather than attempting to approximate the skin edges. Such a wound is allowed to remain open and the dressing is applied inside the wound by lightly packing it with sterile gauze and then covering the packing and wound with a sterile pad. This type of dressing not only prevents subsequent contamination, but also allows the wound an opportunity to rid itself of pus, should an infection develop, as well as all other foreign bodies.

CLOSED WOUNDS

Closed wounds are wounds in which the overlying surface, skin or mucous membrane, is intact. This feature is of considerable importance since it makes the likelihood of an infection within an enclosed wound extremely remote. Closed wounds may be classified as:

1. Contusions
2. Sprains
3. Strains
4. Dislocations
5. Simple fractures
6. Internal injuries

CONTUSIONS

A contusion is a crushing and tearing of tissues without their complete anatomical separation and usually without breaking of the skin. This type of injury is usually the result of trauma following contact with a blunt object. As is the case with all wounds, contusions are immediately followed by bleeding from injured blood vessels and, later and more slowly, the effusion of lymph into the injured area. One of the most prominent signs of a contusion is the discoloration which results from this bleeding. This discoloration is at first red, then black or blue, and finally shades of green or yellow. These color changes are associated with the absorption and decomposition of the effused blood. The immediate swelling is chiefly due to bleeding; the swelling occurring in the next few hours is due to the effusion of lymph. Sharp pain is not a prominent symptom of contusions and lasts only a short time. Tenderness, or pain produced by pressure or motion, is a prominent symptom, with the exception of minor contusions, and persists and gradually diminishes until complete healing has occurred. Disturbance in function is present only in severe contusions of muscle, cartilage, or bone and, in these instances, the disturbance in function chiefly consists of stiffness, clumsiness and disinclination to move the part because of the pain produced by motion. The only deformities present following contusions are those due to the extravasation of blood or lymph. This extravasation frequently results in local collections of blood and lymph, hematomas, blood-blisters, blisters, or deep-seated swellings which at times may cause confusion between a fracture and a contusion. False motion is never present in a contusion. Contusions are ordinarily associated with soft tissues; however, cartilage, periosteum and internal organs often suffer contusions. These injuries may vary in severity from the simple "black and blue" spot, which causes no inconvenience, to an injury in which the major portion of an extremity is rendered temporarily useless. In the presence of a contusion, the possibility of serious injury to underlying structures must always be recognized and this possibility must be excluded before the condition is considered to be an uncomplicated contusion.

Treatment: Contusions are rarely accompanied by systemic symptoms, although shock may be present following certain contusions, such as of the testicle. If shock, unconsciousness, or other systemic symptoms are present, they must be appropriately treated. Most mild contusions require no treatment. Small superficial hematomas or blisters are best left untreated, except for the application of a dressing to protect against premature opening. Blisters that are located in areas, such as the foot

or hand, whether or not they contain blood, cannot ordinarily be fully protected against premature opening. These blisters should be emptied by inserting a sterile needle into the blister through the adjacent normal skin. More severe contusions will require rest of the injured part. This may be accomplished in contusions of the upper extremity by the application of a sling while severe contusions of the lower extremities will usually require rest in bed. Swelling and pain may be alleviated by the early application of ice bags. The absorption of extravasated blood and lymph may be later hastened by the application of moist heat and massage. Restoration of function may be accelerated by as early use of the injured part as possible. The major deterrent to use is pain, and the degree of this pain may be used as a guide for determining the time and extent of movement allowed. In cases in which there is a possibility of a more severe underlying injury, such as a fracture, motion is not advised until this possibility has been ruled out.

SPRAINS AND STRAINS

A sprain is an injury to a joint, usually caused by twisting or pulling, in which the fibers of the joint ligaments and adjacent soft tissues are injured by over-stretching.

A strain is an injury to muscle or tendon, caused by over-stretching, in which some of the fibers of the muscle or tendon, as well as the adjacent soft tissues, are pulled apart.

The severity of these injuries is, in general, dependent upon the number of fibers of ligament, tendon, or muscle that have been pulled apart during the injury. The degree of damage to surrounding soft tissues (blood vessels, nerves, and joint lining) while generally paralleling the degree of damage to the harder structures, is not necessarily the same. Damage to nerves produces pain, damage to blood vessels produces bleeding and later extravasation of lymph, and damage to the synovial membrane (joint lining) produces an excessive collection of fluid in the joint. The damage to the joint ligament, muscle, or tendon results in loss of function, although in most instances the symptoms of pain and swelling brought on by soft tissue injury are the major factors responsible for lost function.

Injuries of this type are associated with pain immediately following the injury, which is quite transitory in the mild cases and tends to be persistent following more severe injuries. Tenderness on pressure at the site of the injury and pain produced by movement of the injured part persist in a diminishing degree until recovery. Swelling at the site of the injury, particularly in sprains, is a very characteristic feature

and may be present in a marked degree. Discoloration due to bleeding under the surface of the skin may be present in most of these injuries, but usually develops several hours after the injury because of the deep location of the bleeding vessels. Muscle injuries are particularly apt to be followed by discoloration. Disturbance in function is a prominent feature following severe sprains and strains. In most cases, this will be temporary and completely disappears after healing. In other instances there may be varying degrees of persistent disfunction, and in still other instances, the original injury may result in an increased susceptibility to recurrent injury. False motion does not occur following injuries of this type. Marked degrees of deformity may result from soft tissue swelling and cause considerable confusion in differentiating certain of these conditions from fractures and dislocations.

Treatment: Systemic symptoms, other than fainting or feelings of faintness, are usually absent. Mild injuries of this type ordinarily require no treatment. However, massage, the application of heat and slight rest of the injured part by "favoring" it, tend to promote comfort.

More severe injuries require restriction of motion to prevent further injury and to provide rest of the injured part. This can be accomplished by adhesive strapping, bandaging, and splinting. In the most severe injuries, these measures to restrict motion must be supplemented by bed rest. Regardless of the severity of the injury, elevation of the injured part and the application of cold are aids used for the comfort of the patient and may tend to reduce the amount of swelling. The later application of heat and mild massage tend to hasten recovery by promoting increased circulation. The re-establishment of normal function will be hastened by as prompt use of the injured part as is possible. Bandaging and strapping are useful adjuncts in this respect since they permit early, limited and usually non-painful motion. The loosening of the bandage or adhesive strapping over a period of days is actually an advantage in most cases, since the degree of loosening permits gradually increasing motion, which in most instances is tolerated by the patient's injury. Those injuries, in which the possibility of a fracture or a dislocation exists, should be treated as fractures or dislocations until proven otherwise. Refer all patients with severe sprains and strains to a physician when available.

DISLOCATIONS

A dislocation is the displacement of bones from their normal relationship at the site of a joint. These injuries are usually caused by pulling, twisting or a combination of the two forces applied to one or

all bones comprising a joint. A dislocation is associated with tearing of some of the ligaments and portions of the ligamentous joint capsule, as well as injury to the synovial membrane, joint cartilage, and adjacent soft tissues, such as blood vessels, nerves, muscles and tendons. At times there may be injury to the periosteum and bone (chip fractures). Following a dislocation, the bones may promptly return to their normal anatomical relationship, but they are more frequently "locked" in an abnormal anatomical relationship. The most commonly dislocated joints are those which are shallow and not strongly protected by powerful ligaments, tendons or muscles and which are subjected to twisting or pulling forces. The commonly dislocated joints are the shoulder and finger joints.

The prominent symptoms of dislocations are severe pain, deformity at the joint, and a marked limitation or absence of normal joint function. A large amount of swelling may later appear due to injury of the synovial membrane and, because of the appearance of this swelling, great difficulty will be encountered in making a correct diagnosis without recourse to x-ray examination. Discoloration of the skin is rarely present unless there has been a large amount of soft tissue injury. False motion of the type ordinarily associated with fractures is not present. Fainting and mild collapse may occur following a dislocation, but true shock does not ordinarily develop unless there are other severe injuries associated with the dislocation.

TREATMENT: The most important phase in the treatment of a dislocation is the early return of the bones to their normal relationship (reduction). Some dislocations, such as dislocations of the finger joints, may be easily reduced by a steady, strong pull on the distal portion of the affected finger. Other joints, such as the shoulder, are more difficult and more dangerous to reduce, since they may be surrounded by important nerves and blood vessels which may be easily injured by clumsy or careless manipulation. Following reduction of the dislocation, a sling, bandage, or splint must be applied for ten days to two weeks to retain the bones in their proper position and thus prevent immediate recurrence of the dislocation. If possible, all suspected dislocations should be x-rayed before and after reduction in order to determine the presence of associated fractures and in order to be certain that a complete reduction of the dislocation has been accomplished. For this and other reasons, patients with dislocations should be referred to a physician when available.

SIMPLE FRACTURES

A simple fracture is any break or crack of a bone without a communication to the exterior through the overlying skin or mucous membrane. Fractures are usually produced by the impact of direct force or the application of twisting or bending forces, or the combination of all three. At the time the bone is broken there is a break in the periosteum or covering of the bone and there is bleeding, not only in the medullary canal of the bone, but also at the site of the periosteal tear. This bleeding results in the formation of a fibrinous clot or callus. Healing is brought about later by growth of connective tissue fibers into the callus and by the still later replacement of the connective tissue with bone. At the time of the fracture, injury to the adjacent soft tissue, such as nerves and muscles, is present in varying degrees.

The direction of the force, its degree and the manner in which it is applied, as well as the site of the fracture, will determine the type and degree of deformity. Deformity may or may not be present. Deformities may be of three main types: angulation, over-riding, or rotation. These deformities result in unnatural positions which are manifested by bending of the part where no joint exists, shortening of the part, and altered relationship of surface landmarks. The detection of fractures in the presence of deformities is obvious. However, many fractures are not associated with obvious deformity and it is the detection of these fractures that will be most difficult without x-ray examination. Other prominent symptoms of fractures are severe pain, swelling, discoloration, limitation of function and at times, abnormal motion. Pain is ordinarily severe and is characteristic of most fractures. Pain is usually present in some degree until the fractured bones are returned to normal position (reduction) and immobilized. Swelling occurs rapidly at the sites of most fractures and quickly obscures certain deformities which could be previously detected. Discoloration of varying degrees is usually present after the second day. Function is ordinarily lost following a fracture, and this is one of the most reliable signs of fracture. Abnormal motion at the site of a fracture may often be found if it is looked for. However, this sort of examination is undesirable, since it may lead to further injury, particularly of the surrounding soft tissues. Fainting, collapse and true shock may occur.

TREATMENT: The immediate treatment of a simple fracture consists in relief of pain and temporary immobilization to make possible safe removal of the patient. Treatment of shock should not be delayed if this condition is present or impending. The Hospital Corpsman will probably be unable to properly reduce a fracture and he should not

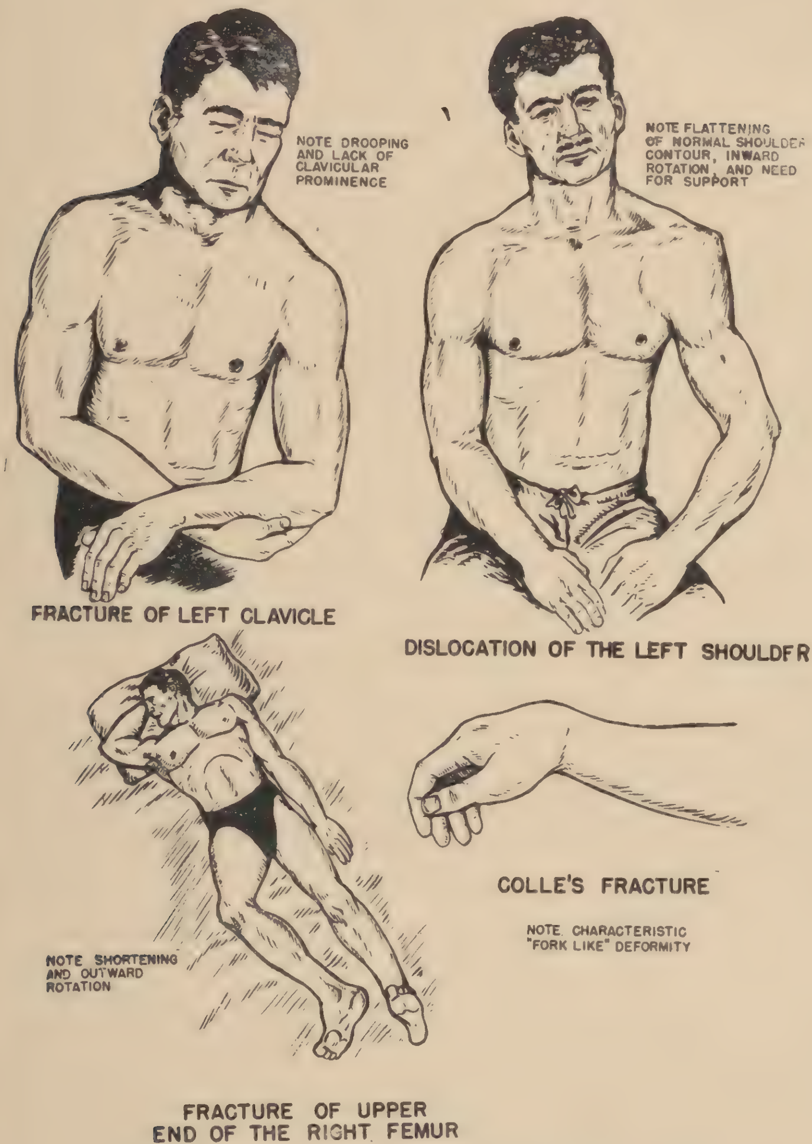


Figure 65. Characteristic attitudes of some common injuries.

attempt to do so. He should limit his attempts at correction of deformity to realignment of the fragments, establishing as nearly as possible a normal contour of the part without attempting to approximate the ends of the fragments. This alignment can best be accomplished with manual traction. In order to obtain traction in a properly controlled manner, the Hospital Corpsman should obtain the aid of an assistant to steady the part nearest the body. The Hospital Corpsman will then be able to pull on the extremity and gently manipulate it into proper alignment. This procedure will be quite painful, but a fracture which requires such a realignment will ordinarily have required morphine for immediate treatment. Fractures that are not associated with unnatural positions should not be manipulated. These fractures and those which have been aligned must then be immobilized by means of suitable splints and this immobilization maintained until the patient can be transferred to the care of a physician.

In general, pillow splints which have been made more rigid with strips of basswood are most satisfactory for treatment of fractures of the lower extremities, with the exclusion of fractures of the toes, as well as temporary splints for treatment of major fractures of the upper extremity. While immobilization without complete reduction of the fracture does not stop all pain, it does greatly reduce the pain. Pain that cannot be tolerated and persists for more than a few hours is most likely the result of the improper application of splints. The application of ice and the elevation of the part will tend to prevent and reduce swelling as well as promote comfort. During the first few days following the injury, give the patient sedative drugs to relieve restlessness and promote sleep. As nearly a normal diet as possible is desirable. The advice of a physician should be obtained as quickly as possible if a fracture is suspected.

INJURIES TO INTERNAL ORGANS

An injury may cause little or no damage to the skin, but may cause very serious damage to the organs located beneath the surface of the body. An injury of this type occurring in the extremities may produce serious damage to large blood vessels and nerve trunks, in addition to the other types of closed wounds. An injury to a large artery may result in a thrombosis within the vessel and consequent gangrene of all or part of the extremity. Severe injury to a nerve trunk may lead to varying degrees of anesthesia and paralysis. Injuries to the head may cause contusion and laceration of the brain. Injuries to the chest and abdomen are often associated with laceration or contusion of any of the under-

lying structures. The symptoms commonly associated with these injuries are those of shock and internal hemorrhage, in addition to certain special symptoms peculiar to the injured organ. The most important of these injuries of internal organs are discussed under Injuries to Special Organs.

OPEN WOUNDS

An open wound is an injury in which there is a break in the skin or mucous membrane and varying degrees of damage to underlying structures. Open wounds may be separated into: (1) *Incised wounds:* Those which are caused by sharp cutting instruments resulting in relatively smooth and uniform edges. (2) *Lacerated wounds:* Those which are caused by blunt or rough-edged instruments resulting in jagged, widely-spaced edges which cannot be readily approximated. (3) *Puncture or penetrating wounds:* Those which are caused by sharp, pointed instruments or missiles resulting in a wound with a small portal of entry and varying degrees of depth. (4) *Abrasions or "friction burns":* Those which are caused by friction between the skin surface and some object, rough or smooth, resulting in the loss of the superficial layers of the skin. (5) *Avulsions:* Those which are caused by forces which tear away a section of tissue, resulting in an actual loss of tissue and difficulty in approximating the wound edges. (6) *Compound fractures:* Those which are caused by forces which break bone and create a communicating channel from the fracture to a break in the overlying skin or mucous membrane.

INCISED WOUNDS

Incised wounds impart relatively little injury to the skin adjacent to the wound edges. The chief importance of these wounds lies in the potential damage to deeper structures and in hemorrhage. Depending upon the location of the wound, structures such as tendons, nerves, muscles, joints, and special organs, may be injured. Bleeding from this type of wound is usually profuse. The danger of severe hemorrhage is always present in a wound of this type and is dependent upon whether or not a large vessel has been severed. This bleeding, however, is ordinarily very easy to control by approximation of the wound edges and the local application of pressure. Should an injury to one of the deeper organs occur, special symptoms as a result of loss or impairment of function of the special organ will result. A careful examination should be made to ascertain such an eventuality following all deep incised

wounds. One example of such a symptom is the inability to flex a finger following the severance of a flexor tendon caused by an incised wound upon the palmar surface of a finger.

Systemic symptoms following incised wounds are quite rare. Since pain and extensive tissue injury is minimal, shock is extremely rare and faintness or fainting, if they occur, are ordinarily an emotional response to the sight of blood. Excessive blood loss will result in the systemic symptoms associated with severe hemorrhage.

Contamination of incised wounds at the time of injury is relatively small. These wounds are ordinarily inflicted by sharp instruments which carry few micro-organisms into the wound. The immediate fairly profuse hemorrhage associated with most of these wounds acts as an excellent irrigant which further reduces the number of micro-organisms in the wound. The sharpness of the instrument produces relatively little damage to the tissues. This fact together with the absence of foreign bodies creates an adverse situation for multiplication and growth of remaining micro-organisms. The smooth wound edges and their relative ease of approximation, together with the absence of material in the wound requiring subsequent drainage, allows for immediate closure and the application of a dressing which need not be changed until wound healing is partially established (five to seven days). The approximation of most incised wounds can be accomplished by the application of a simple sterile dressing which will simultaneously control bleeding and seal the wound from later contamination. Frequently, some superficial incisions gape because they are located in areas where motion of the part places tension on wound edges. These wounds should be covered with a simple, sterile dressing and the part splinted or immobilized in such a way that all skin tension is relaxed and maintained until healing is well established. Gaping incised wounds of moderate depth, the edges of which are not under more than slight tension, may be closed with adhesive tape ("butterfly" dressings). This type of closure, along with pressure dressings, will adequately close most of the incised wounds the Hospital Corpsman will be called upon to treat. Deep wounds and moderately deep wounds whose edges are under tension, require suturing. All dressings applied to these wounds must be sterile and all procedures should be performed in an aseptic manner. The danger of tetanus and other special infections is negligible in this type of wound.

These wounds ordinarily heal with a fine scar and there is ordinarily no loss of function except that which may result from infection or damage to underlying structures.

LACERATED WOUNDS

Lacerated wounds produce considerable tearing, crushing and complete destruction of skin in varying degrees. The damage to deeper structures is variable and may, in some instances, be marked. An estimation of the extent of damage to the deeper structures should be made by examining for altered or lost function of the organs beneath the site of injury. Because the force causing the injury is dispersed over a greater surface area, the depth of these wounds is usually less than is the case with incised wounds. Injury to deeper structures is characterized by crushing and tearing rather than simple separation of continuity. Hemorrhage following lacerated wounds may be profuse if a large blood vessel has been involved. Ordinarily, bleeding is not profuse in spite of fairly extensive injury and the minor bleeding that does occur stops promptly and spontaneously. Profuse bleeding may be easily controlled by the application of local pressure.

Because of the large amount of tissue damage, pain at the time of injury is a prominent symptom of extensive lacerations. This pain quickly subsides and is followed by local tissue tenderness. The likelihood of shock is in proportion to the extent of tissue damage and pain. Systemic symptoms of hemorrhage are dependent upon the quantity of blood lost.

The nature of a lacerated wound affords an opportunity for marked contamination of the wound at the time of injury. The relatively small amount of bleeding that ordinarily follows these injuries does not allow adequate, automatic cleansing of the wound from within. Foreign bodies in the form of bits of clothing, gravel and other debris are frequently introduced into the wound at the time of injury and the extensive devitalization of tissue and the collection of blood clots in the recesses of the wound provide a favorable environment for the growth of contaminating micro-organisms. In order to prevent the ill effects of wound infection, these conditions should be corrected as much as possible, as previously discussed. The extent of irrigation necessary and the amount of devitalized tissue that must be removed will depend upon the characteristics of each individual wound. Small superficial lacerations may be treated by cleansing with white soap and water and the application of a sterile vaseline or boric acid ointment dressing. Sulfanilimide powder may be lightly sprinkled on such a wound. Deep lacerations with many recesses will require thorough irrigation with normal saline and extreme care in the removal of foreign bodies and tissue debris. These wounds require the local application of sulfanilimide powder and should be loosely packed open with sterile vaseline

gauze and covered with a sterile dressing. The prophylactic administration of the sulfonamide drugs or penicillin is necessary. Deep lacerations, particularly those associated with the introduction of foreign bodies, are a potential source of tetanus, and tetanus prophylaxis (antitoxin, or toxoid if the patient has been previously immunized) should be administered to these patients.

The unevenness of the wound edges and the loss of tissue between these edges do not allow for the perfect closure of most lacerated wounds. Superficial lacerations may be closed with relatively little danger of subsequent infection and an adequate closure can be obtained by the application of sterile vaseline or boric acid ointment dressings. Wounds which gape because of tension on the wound edges through motion of the part may be adequately closed by the above dressing plus immobilization. Other lacerated wounds should be loosely packed with sterile vaseline gauze and allowed to heal from the bottom.

The Hospital Corpsman's chief contribution to the restoration of function is the prevention and proper control of infection. This will not only prevent further damage caused by infection but will also allow for an earlier application of restorative measures, should they be necessary. Patients with severe lacerations should be referred to a physician when available.

PUNCTURE OR PENETRATING WOUNDS

Puncture or penetrating wounds are usually associated with little skin damage and their chief danger lies in the potentialities of deeper injury and infection. The danger of serious injury to deeper structures is dependent upon the puncture of a vital organ, such as the brain, heart, lung, or liver. The danger of infection is of two types. Virulent micro-organisms may be deposited in the wound by the penetrating object such as rabies virus from dog bite, virulent streptococci from a human bite, and tetanus spores from a nail. Another danger of infection is any perforation of the respiratory or gastro-intestinal tracts which causes contamination of the wound and adjacent tissues by the escape of micro-organisms from the perforated organ. External hemorrhage from penetrating wounds is ordinarily very slight. Internal bleeding, however, is common, but usually is not serious unless there is a communication with a body cavity. In instances of this type, death may result. Since the local control of internal hemorrhage is beyond the ability of the Hospital Corpsman, his treatment will be limited to the use of supportive measures. Systemic symptoms are not uncommon following penetrating wounds and are dependent upon the presence of

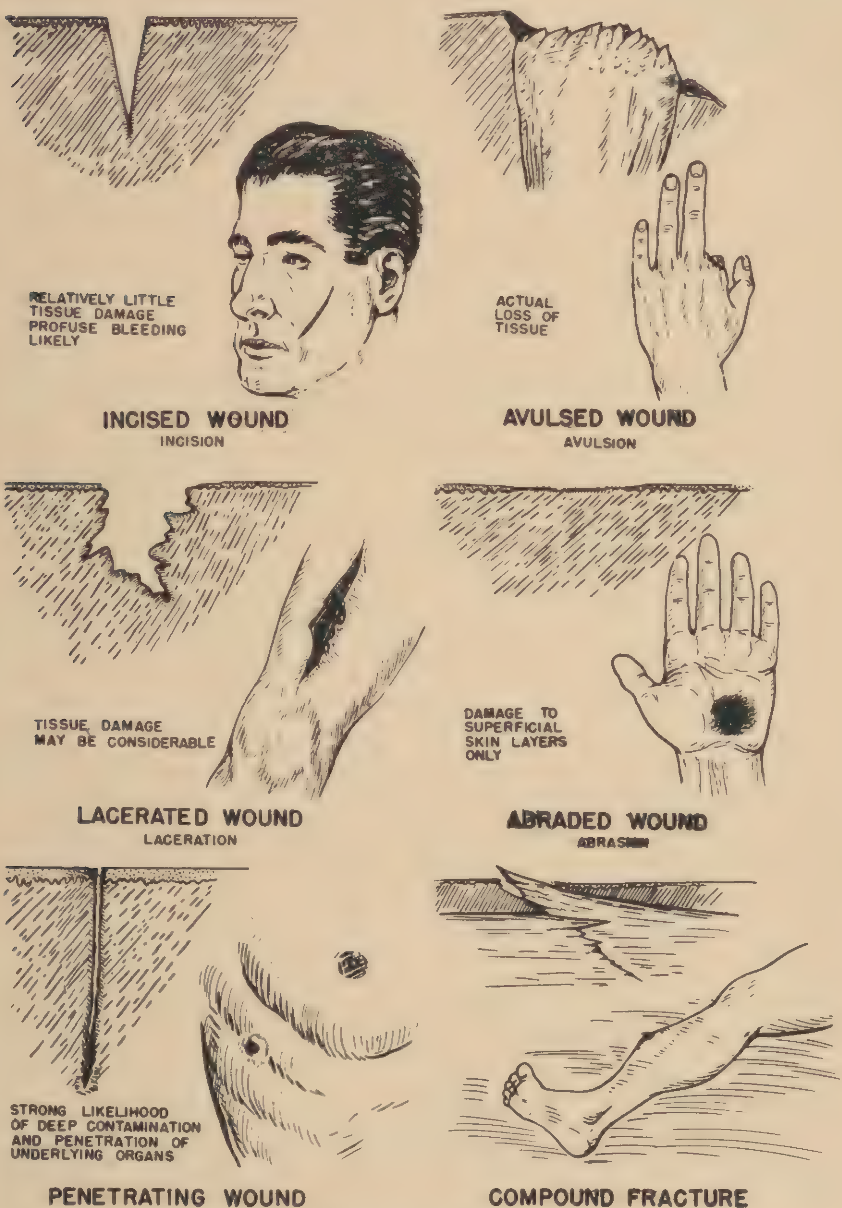


Figure 66. Open wounds.

internal hemorrhage, the extent of underlying tissue damage, and the organ involved. The size of the skin wound is no indication of the underlying tissue damage and organs that are located some distance from the site of entry may be gravely injured, particularly after bullet wounds. The number of micro-organisms introduced into the body by puncture and penetrating wounds is usually small. The chief danger lies in the degree of virulence of these micro-organisms. Since these wounds do not bleed freely, there is little or no self-cleansing of the wound. Because the wound opening is small, it becomes quickly sealed, which prevents the escape of foreign bodies and tissue debris and tends to encourage a spreading infection rather than a localized one. This type of wound is particularly suitable for the development of tetanus. No local treatment is required for superficial puncture wounds except soap and water cleansing. Dog bites should be treated by thorough cleansing and copious irrigation of the wound with soap solution. This treatment is a satisfactory aid for preventing rabies but must be supplemented by observation of the biting animal and rabies vaccination, should the animal prove to be infected. Human bites should be thoroughly irrigated with normal saline and wet boric acid solution compresses applied. Tetanus prophylaxis should be given following these wounds except those of a very superficial nature and those caused by human and animal bites. Wounds which are likely to involve penetration of a portion of the respiratory or gastro-intestinal tract should be followed by the prophylactic administration of either the sulfonamides or penicillin. A simple sterile gauze dressing will ordinarily suffice as a covering for these wounds. All potentially dangerous puncture wounds should be referred to a physician as soon as possible.

Puncture wounds caused by the bite of poisonous snakes involve the danger of absorption of the toxin and the danger of tetanus infection. Immediately following the bite of a poisonous snake, a wide tourniquet should be applied a short distance above the wound tightly enough to stop venous circulation. The bite should be immediately incised so as to provide for the free flow of blood. The elimination of snake venom may be aided by suction applied to the wound, preferably by means other than by mouth. The tourniquet should be loosened at forty-five minute intervals in order to temporarily re-establish normal circulation. The tourniquet should be reapplied as frequently as is necessary. Antisnake venom should be administered if the appropriate type is available and tetanus prophylaxis should be instituted.

ABRASIONS OR "FRICTION BURNS"

Abrasions or "friction burns" are associated with considerable injury to the superficial layers of the skin and the underlying structures are undamaged. Since large vessels are undamaged in this type of injury, bleeding consists of minor capillary oozing. Pain is moderate in fairly large abraded areas and is apt to persist for several hours. Shock and other general symptoms are absent. The only loss of function present is that associated with pain upon use of the affected area. Due to the nature of the wound, small foreign bodies, including bacteria, are frequently imbedded in many of these wounds. Foreign bodies, such as gravel, cinders, or dirt, should be removed by soaking the abraded area with soap and water and those remaining should be removed with sterile forceps. If these particles are allowed to remain, they may cause permanent discoloration of the skin at the site of injury. While large numbers of bacteria are introduced into these wounds, they are implanted in the superficial layers of the skin, and infections that follow are usually mild because of their superficial location. These wounds should be thoroughly washed with soap and water, lightly dusted with sulfanilamide powder and covered with a sterile vaseline or boric acid ointment dressing. A changing of dressing will be required at daily intervals or oftener during the first few days after injury. No permanent loss of function should result from this type of injury.

AVULSIONS

Avulsions are distinct from other open wounds in that they involve the loss of a considerable quantity of tissue. This loss of tissue may vary in degree from the loss of a small piece of a fleshy part of the body, as may be caused by a shrapnel wound, to the loss of an entire extremity, which may result from entanglement of the extremity in moving machinery. The possibility of severe hemorrhage and shock is great in severe avulsions, and the use of the tourniquet and pressure points to stop hemorrhage may be life-saving. Minor avulsions may be considered and treated in the same manner as minor lacerations. The treatment of major avulsions will first require control of hemorrhage and shock. The later treatment of these conditions is identical with that applied to severe lacerations. Obtain the advice of a physician as quickly as possible.

COMPOUND FRACTURES

Compound fractures possess all the characteristics of simple fractures plus the dangers associated with deep lacerated wounds. Forces which produce compound fractures are usually of such a nature as to cause other serious injury to intervening soft tissues. For this reason, bleeding into and around the deep tissues is also pronounced and danger of injury to nerves, muscles, and blood vessels is increased. External bleeding is generally not severe but may be great if a large vessel is penetrated. Bleeding can usually be controlled by the application of local pressure. Pain is marked and shock to some degree is almost always present. The relief of pain and shock, as well as control of severe hemorrhage, requires prompt treatment.

The forces that produce compound fractures are generally such that these wounds are heavily contaminated at the time of the accident and immediately after injury, and the return of the bones to approximately their normal position is prone to carry contamination into the depths of the wound. This tendency is, to a certain extent, overcome by the outward flow of blood. Even though the risk of carrying infection into the deeper tissues by retraction of the broken ends of the bone is great, not to retract these bones carries an even greater risk of severe infection. Irrigation of these wounds should not be performed by the Hospital Corpsman. These wounds should first be treated by removing obviously devitalized tissue including bone fragments. Sulfanilamide powder, approximately 5 grams, should be sprinkled in the wound and on the protruding bone ends and a sterile dressing applied. By the use of manual traction, the projecting fragments should be retracted and reasonably good alignment of the extremity be achieved. The maintenance of proper alignment and prevention of further movement of the fractured bones are achieved by the application of well-padded splints. In order to best prevent motion, the splint should be applied to immobilize the joints on either end of the fractured bone. Splints should be applied so that the dressing over the wound is not covered. This facilitates subsequent changes of dressings without disturbing the splint. Unless a large vessel has been punctured, a simple dressing is all that is required for the control of hemorrhage. The bleeding from large vessels may be controlled by the application of pressure dressings. All of these wounds should be considered as infected and sulfanilamide or penicillin prophylactic treatment instituted. Tetanus prophylaxis should never be omitted. Obtain the advice of a physician as quickly as possible.

BURNS

Most burns are caused by contact with heat. The intensity of this heat, and the length of time it is applied, will determine the degree of local tissue damage. Similar tissue injuries may be produced by contact with chemicals (acids, alkalis, caustics, and irritant gases), ultraviolet light (sunburn), x-ray, and radium.

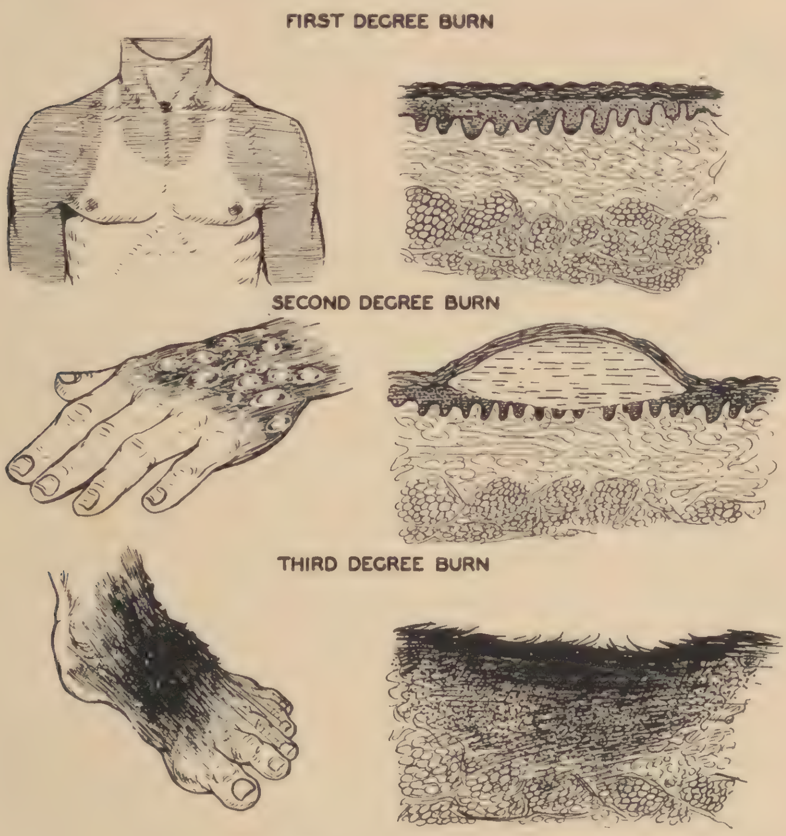


Figure 67. Burns.

Burns are commonly classified according to degree and the extent of surface area involved. The local treatment of the burn will depend upon its degree of severity. The general treatment of the patient will depend on the quantity of tissue injured which is computed by an estimation not only of the degree of depth of injury, but also of the surface area involved. Burns are ordinarily classified into three degrees of severity. First degree burns are those which produce only reddening

of the skin (erythema). Second degree burns are those which produce blister formation. Third degree burns are those which damage the deeper layers of the skin and underlying structures. Third degree burns will vary in appearance in accordance with the amount of tissue coagulation (cooking). They may range in color from white to black (charring). The surface area of a burn is probably of more importance than the degree of the burn since the total quantity of tissue damaged may be more accurately estimated by determining the area of the skin involved rather than the depth at any location. Burns, other than sunburn, regardless of degree, that involve more than 10% of the body surface should be regarded as serious. A burn that involves more than 30% of the body surface is extremely dangerous and often fatal. Most burns that involve more than very small areas will vary in degree in different locations. However, the larger the area involved, the greater is the likelihood of burns of severe degree. An estimation of the extent of surface involved in any burn may be computed by comparing it with the palm of the hand. An area equal in size to the palm of the hand may be considered as 1% of the total body surface. Hence, the number of "hands" required to cover the burned surface equals the percent of body area involved.

A first degree burn consists simply of an area of redness with a mild degree of swelling. The impairment of function present will depend upon the extent of the burn and is due solely to pain caused by movement, and tenderness induced by the rubbing of clothing or other substances on the burned area. If the area is extensive, there may also be enough tissue swelling to produce stiffness. There is no bleeding, consequently no discoloration other than the redness produced by engorgement of the local blood vessels. There may be a partial superficial devitalization of tissue but this is minimal. It is the partial devitalization of the superficial tissues that is responsible for the desquamation (peeling) that occurs several days after the burn. Micro-organisms are not introduced into the burned area at the time of injury and, since the skin remains intact, the danger of introducing micro-organisms into the deeper layers of the skin after the injury is minimal. Thus infections following first degree burns are extremely unlikely.

The treatment of first degree burns is chiefly directed toward the treatment of the skin unless a large area has been burned. The treatment of the skin is directed primarily toward the relief of pain and discomfort. This may be accomplished by the application of emollients. For most purposes, petrolatum with or without a covering of gauze, dependent upon the amount of protection needed, is all that is required. The pain from these burns is usually well tolerated unless an extremely

large area has been burned. If the pain is severe and not relieved by petrolatum dressing, an ointment containing a local skin anesthetic may be applied. First degree burns involving more than 20% of the body surface, except those caused by sunburn, are apt to be accompanied by shock. Prophylactic treatment consisting of bed rest with the lower portion of the body elevated, relief of pain, and adequate fluid intake, should be started without delay. If signs of secondary shock appear, the administration of plasma should be started at once. The danger of shock may be present for as long as seventy-two hours, and the patient should be protected and carefully observed during this period. Sunburn requires considerably longer exposure for its development than heat burn. This reason probably accounts for the fact that much larger areas of skin surface may be sunburned without detrimental systemic effects. The danger of shock is, however, not completely eliminated and severe sunburn covering large skin areas requires careful observation and treatment.

A second degree burn consists of redness and swelling of the skin at the site of injury with sufficient damage to the superficial layers of the skin so that they are separated from the deeper layers by the extravasation of fluid in sufficient quantities to produce blisters. These blisters may be extremely fragile and may be broken at the time of the burn or at some later date. If the blisters are broken, the area appears as a red, slightly edematous, denuded wound. Thus a second degree burn may be compared to an open wound in which the superficial layers of the skin have been completely devitalized, and in which there is a partial devitalization confined to the slightly deeper layers. The nature of the agent producing the burn is such that contamination of the wound is not caused by the burning agent. However, micro-organisms can be and frequently are introduced immediately after the injury or at any time prior to complete healing. The presence of partially devitalized tissue encourages infection, but the open and superficial nature of the wound tends to maintain the infection at a superficial level. Impairment of function following a second degree burn is dependent on the extent of the burn and is produced chiefly by pain, tenderness, and stiffness. Second degree burns involving less than 10% of the body surface are ordinarily not associated with systemic symptoms.

The local treatment of a second degree burn is directed toward the local relief of pain and the prevention of infection. This may be accomplished by the application of sterile petrolatum-impregnated gauze dressings. These dressings should be left in place for at least seventy-two hours. Blisters that have not ruptured spontaneously should ordinarily be left intact and protected against premature opening in order to

maintain the wound in a closed state as long as possible. Burns, in which the blisters have been opened, should be treated in exactly the same manner, except for a preliminary dusting of sulfanilamide powder. No effort should be made to clean these burns and no antiseptic solution should be applied.

Second degree burns, involving more than 10% of the body surface, are very likely to be associated with systemic symptoms and those involving more than 30% of the skin surface are apt to be fatal. Shock usually follows second degree burns involving more than 10% of the body surface and prophylactic measures must be instituted before signs of such shock develop. The danger of shock is present for a period of seventy-two hours. The usual causes of shock (pain, emotional disturbances, and tissue destruction) are present following burns. In addition, there is a loss of the fluid portion of the blood from the blood vessels, in the region of the burn, into the tissue spaces as edema and as escaping fluid from the burned area. This loss of fluid can be reduced to a moderate degree by the application of pressure dressings over the previously applied sterile petrolatum dressings. The fluid which has already been lost from the blood may be replaced by the intravenous infusion of plasma. To accomplish this replacement of fluids, 500 cc. of plasma should be given during the first twenty-four hours for each 5% of the body surface burned. The administration of plasma after the first twenty-four hours may be gradually reduced and the actual amount given will depend upon the presence of edema, the escape of fluids from the burned area, the presence or threat of shock, and the ability of the patient to take fluids by mouth. The amount of fluids, other than plasma, given by mouth or by vein during the first twenty-four hours should not exceed the amount of plasma given during that period. The other measures used in the treatment and prevention of shock must not be omitted even though special attention is devoted to the administration of plasma. The treatment of the patient during the first seventy-two hours will consist chiefly of preventing and controlling shock. Another measure of treatment includes the maintenance of an adequate output of urine. The amount of urine excreted daily should be 1,000 cc. or more and can be provided by adjusting the amount of fluids given the patient. In addition, an adequate amount of nourishment must be given. Patients with very severe burns will be unable to ingest more than a small amount of liquid diet during the first three to four days. These liquids should be made as nutritious as possible by the addition of as much sugar as can be tolerated by the patient. In addition, these severely burned patients should receive intravenous glucose to supplement the carbohydrates taken by mouth. Ordinarily 2,000 or 3,000 cc. of 5%

glucose solution per day will suffice. The plasma that has been administered intravenously for the control of shock will supply additional nourishment through its protein content.

The treatment of a patient during the first seventy-two hours is extremely important as this is the most critical period of the injury. The Hospital Corpsman should seek the advice of a physician as soon as possible regarding treatment of the patient. Subsequent treatment is directed toward the maintenance of adequate fluid and food intake, and the further prevention of infection. Even though the patient survives the first seventy-two hour period, the patient should not be considered as out of danger since serious complications are not uncommon during the first two weeks. The aid and advice of a physician should be obtained when possible.

Prevention of infection is an extremely important part of the treatment of all severe and extensive burns. This treatment is begun when sulfanilamide powder is applied to the burn when it is first dressed. Burns that cover extensive areas of the skin need additional protection against infection and this may be provided by the administration of sulfonamide drugs by mouth or penicillin intramuscularly. This prophylactic treatment should be continued until all danger of infection is passed.

A third degree burn consists of an area in which the deepest layers of the skin are partially or fully devitalized. This change is made apparent by the obvious coagulation ("cooking") of the tissue and may be so severe that the tissues are actually charred. Structures beneath the skin, to and including bone, may also be severely damaged in such a burn. An estimation of the extent of damage to the deeper structures may be obtained by appraisal of the functional ability of these deeper structures. Except for its appearance and damage to underlying structures, the symptoms associated with third degree burns are identical with those associated with second degree burns. When compared with a second degree burn of similar size, however, a third degree burn will naturally present symptoms of greater intensity and is of greater danger to the patient. The risk of serious infection and scarring in third degree burns is likewise greater than is the case with second degree burns, since these burns penetrate more deeply. The treatment of both local and systemic symptoms is the same as was described for second degree burns.

In order to maintain the burned area in the most favorable condition for restoration of function following healing, great care should be exercised, not only to prevent infection but also to prevent undesirable

scarring. Burns around joints should be dressed in such a manner that the part is splinted in an extended position. Adjacent surfaces should be dressed in such a way that they are separated. Motion of the burned area should be instituted as quickly as the patient can tolerate the pain associated with this motion.

The Hospital Corpsman may be asked to treat an ulcer in a locality to which x-ray or radium therapy has been administered. Such an ulcer is commonly referred to as an x-ray or radium "burn." Because of the devitalization of tissue and the prolonged effect of x-ray and radium, these ulcers are apt to heal slowly. Their treatment is the same as that applied to any open wound of similar size and location.

Electrical burns should be considered and treated the same as heat burns. These burns are usually not extensive in area, but may be extremely deep. They are usually located on the hands. In addition to the localized burn, there may be sufficient electrical shock to cause irreparable damage to the central nervous system and, in the case of low voltage (110-220 volts), to the heart. Artificial respiration should be administered to such a person for a half hour after all signs of life have disappeared, before it is concluded that he has died.

Chemical burns should be treated in the same manner as heat burns except for thorough irrigation in running water for a minimum of five minutes before dressings are applied.

INJURIES DUE TO EXPOSURE

FROSTBITE

Prolonged exposure to cold may cause freezing of tissues. Upon thawing, mild cases are characterized by a purplish discoloration of the skin with varying degrees of swelling, numbness, and pain. Subsequent exposure to cold frequently brings about a return of pain, burning, and itching to the frost bitten area (chilblains). Severe cases may cause gangrene.

Treatment of these conditions consists of elevation of the affected part to improve the return flow of blood, and the gradual elevation of temperature of the part by allowing it to thaw in a cool room at room temperature, and by protecting the damaged part against further injury and infection. Friction or heat should never be applied to these injuries. The injured part should be protected from bedclothes by a cradle or other structure. Infection should be guarded against by sprinkling open lesions with sulfanilamide powder and covering them with dry sterile dressings. Tight dressings must be avoided. If the injury is more than superficial in nature, the injured part should not be placed in a de-

pendent position or used too quickly after injury. The amount of pain that occurs following the use of the part is a fairly good guide to determine whether or not it should be used. If gangrene is suspected, the advice of a physician should be obtained as soon as possible.

"IMMERSION FOOT"

Immersion foot occurs as a result of prolonged exposure to cold and wet. The changes that occur in the tissues of the feet are primarily the result of inadequate circulation of blood. It is thought that the prolonged exposure to cold damages the capillaries and thus produces extravasation of fluid into the tissue spaces. Edema is likewise caused by cramped positions, tight shoes and clothing. Once edema is established, further constriction is produced and this in turn causes more edema. In addition, the cold tends to cause clotting within the small blood vessels which still further reduces circulation. The circulatory changes produce in varying degree, swollen, painful, purplish-red feet. The skin overlying these feet is often macerated and blistered. Treatment is directed primarily toward the relief of pain, prevention of infection, prevention of further injury, and the restoration of circulation. The control of pain may necessitate the use of morphine during the early stages of treatment; however, the use of this drug should be avoided if possible. Most of the pain associated with this condition is caused by an inadequate oxygen supply and those measures used to restore circulation greatly aid in the diminution of pain. Extreme care must be exercised to prevent infection. This may best be accomplished by sprinkling sulfanilamide powder over the injured part and covering it loosely with sterile gauze. Prophylactic doses of the sulfonamides or penicillin should be administered as well as prophylaxis against tetanus. Antiseptic solutions, ointments, and wet dressings should never be applied to the injured area. The damaged part must be protected against further injury caused by friction or pressure. Massage or rubbing of the injured area should never be performed, bedclothes and other garments should be kept off the injured part, and great care must be exercised that dressings are not constricting. The entire leg should be supported upon a pillow so that the weight is distributed in such a manner that it is carried by normal tissues rather than by the heel of the injured foot. The leg should be turned frequently as further insurance against continued pressure on any one spot. Venous circulation may be improved by elevating the extremity and by avoiding compression of the veins through constricting dressings, sharp flexion of the knee, and prolonged pressure on any single area. Since it is impossible to immediately

improve the supply of oxygenated blood to the part, it is necessary to maintain the tissues in a state which requires less oxygen. This may be accomplished by keeping the skin temperature of the injured foot at approximately 70° F. This lowered temperature may be maintained through the use of ice bags. The injured foot must first be covered with a dry bath towel and the icebags wrapped in absorbent cotton and covered with rubber sheeting. In this way no moisture is transmitted to the injured foot and protection against over-cooling is avoided. Extreme care must be exercised to prevent pressure or excessive weight on any part of the injured foot. The number of icebags may be gradually reduced as circulation improves. When this has been achieved, the foot should be left exposed to room temperature and cooled with air from an electric fan. The circulation should be fairly well established within a period of ten days, except in severely damaged feet. The advice of a physician should be obtained as quickly as possible during the treatment of these patients.

HEAT STROKE AND HEAT EXHAUSTION

Excessive exposure to intense heat, particularly when it is associated with high humidity, is prone to produce heat stroke (sunstroke) and heat exhaustion.

Heat stroke is usually very rapid in onset and is characterized by high fever (temperatures up to 110°F. have been recorded) ; intensely hot, dry skin; red, flushed face; delirium; and unconsciousness. Symptoms such as headache, dizziness, a feeling of oppression and restlessness may precede the onset of the above symptoms. Heat exhaustion is characterized by a more gradual onset and is a milder condition than heat stroke. It is characterized by subnormal temperature; pale, cold, clammy skin; weak pulse; rapid, shallow respiration; faintness; and rarely, unconsciousness.

Both of these conditions are treated by the prompt removal of the patient to as shady, cool, well-ventilated a place as is immediately available. Then efforts are made to return the temperature to normal. The individual in heat exhaustion should be wrapped in warm blankets and the lower portion of his body elevated. The clothing of the individual with heat stroke should be removed and cold water sprayed over his skin surface. In conjunction with the application of cold water, friction must be applied to the skin through massage. If possible this should be performed by two or more individuals. The most common mistake is to apply too cold water and to apply too little friction. This treatment should be maintained until the temperature falls to 102° F.,

orally. Careful check must be made of the patient's temperature and if it starts to rise again, the treatment should be renewed. When the patient is able to swallow, cold normal saline solution in increasing quantities should be given by mouth in both heat stroke and heat exhaustion. Since these conditions may recur under similar circumstances, these men should avoid work in a hot, humid environment.

INFECTED WOUNDS

Infection of a wound results when virulent micro-organisms gain entry into the wound and establish themselves to the detriment of the body. Infected wounds are ordinarily characterized by increased local pain and tenderness, redness, swelling, increased local temperature, and, later, the formation of pus. This infection may remain localized or it may spread. A spreading infection is often characterized by inflammation of the lymph channels (red streaks leading away from the wound), pain, tenderness, and swelling in the lymph nodes draining the infected region. The margins that usually demarcate the infected area are ill-defined and spreading. Systemic symptoms are not ordinarily present with localized infections, but usually occur when the infection spreads and involves more tissue. At times, systemic symptoms may develop before signs of local infection appear. The systemic symptoms of an infected wound are those of infection in general, namely: elevated temperature, rapid pulse, lassitude, vague general body aching, and loss of appetite. These symptoms may be initiated by a chill.

The local treatment of an infected wound is directed toward the mechanical cleansing of the wound, the improvement of circulation to the wound, and the elimination of micro-organisms within the wound. These aims are accomplished by application of warm, wet, boric acid or magnesium sulfate compresses (intermittent or continuous depending on the severity of infection), elevation and partial immobilization of the infected area. If the wound edges have been approximated, they should be opened to promote drainage and to prevent pocketing. The sulfonamide drugs or penicillin should be administered.

If systemic symptoms are present, the patient should be placed in bed to provide maximum rest; the diet should be appropriately adjusted; fluid intake should be maintained at a level that permits the excretion of 1000 to 1500 cc. of urine daily; and relief from symptoms, such as pain and restlessness, should be provided in order to maintain body resistance at as high a level as possible. In the presence of a rapidly spreading infection and marked systemic symptoms, the advice of a physician should be obtained as quickly as possible.

SYMPTOMS AND TREATMENT OF INJURIES TO SPECIAL ORGANS

Because of the special functions performed by certain organs of the body, special symptoms arise when these organs are injured. In addition, special forms of treatment are required in order to most adequately preserve the life of the injured person and to provide as great an opportunity as possible for the restoration of function of the injured organ. For the convenience of the reader, injuries to special organs are grouped according to anatomical location.

HEAD

Scalp: *Incised and lacerated wounds* of the scalp are prone to bleed profusely and the wound edges usually gape. These wounds should not be sutured but the wound edges may be approximated by the skillful application of pressure dressings. Bleeding may be easily controlled by pressure dressings. Because of the rich blood supply of this area, partially detached segments of scalp will often survive if they are replaced immediately following injury.

Face: *Incised and lacerated wounds* of the face require special care in order to prevent facial disfigurement and loss of function of certain organs, such as the lip or eyelid. These wounds tend to bleed profusely and to gape. Bleeding may be readily controlled by the application of pressure and gaping may be overcome by "butterfly" adhesive strips or sutures. Care must be applied to approximate the skin edges as accurately as possible. The extremely rich blood supply to this area allows for satisfactory healing following the approximation of wound edges, even though a fairly large amount of intervening tissue has been lost. Partially detached segments of the skin of the face, including the ear and nose, will often heal satisfactorily if they are replaced immediately after injury. Care must be exercised to prevent infection because of the danger of excessive scarring and the spread of this infection to vital organs.

Eye: *Contusions* of the eye are frequently followed by bleeding beneath the conjunctiva as well as hemorrhage into the surrounding tissues. This bleeding and injury may cause marked swelling and discoloration of the surrounding tissues which is spectacular in appearance, but not necessarily serious. These conditions are treated as any other contusion except that accumulated secretions should be removed from the eye by frequent irrigations, if necessary.

Open wounds of the eyeball may result in temporary or permanent

loss of sight. The Hospital Corpsman's treatment of this condition is directed primarily toward the prevention of infection. This may be best accomplished by the application of a sterile dressing and the prophylactic administration of the sulfonamides or penicillin. The advice of a physician should be obtained as quickly as possible.

Foreign bodies of the eye are of three types: those which are loose, those which are imbedded in the cornea, and those which are imbedded in the deeper structures of the eye. The loose foreign bodies are easily removed by an applicator or by irrigation. Foreign bodies that are loosely imbedded in the cornea may be removed by gentle manipulations with an applicator. If this procedure fails, the foreign body should be allowed to remain. The relief of pain and prophylaxis against infection may be accomplished by the application of an anesthetic, antiseptic eye ointment. The eye should be covered with a sterile dressing and the advice of a physician obtained as soon as possible. Deeply imbedded foreign bodies should be considered and treated as an open wound of the eye.

Chemical burns of the eye require thorough irrigation with large quantities of tap water. A buffer solution, such as sodium bicarbonate, is superior to tap water for the removal of both acids and alkalis, provided it is immediately available. Irrigation of the eye following such an injury should not be delayed by attempts to locate such a buffer solution. Attempts to neutralize chemical burns of the eye by the use of an acid for an alkali or vice versa, usually result in more damage to the eye. The follow-up care of these injuries consists of the relief of pain and prevention of adhesions by the application of an anesthetic, antiseptic ophthalmic ointment plus the application of a sterile dressing.

NOSE: *Contusions* of the nose may be associated with bleeding, swelling, possible fracture, and blue-black discoloration. Even though this injury is somewhat alarming, the inherent danger is small. The restoration of the nose to its normal appearance may be accomplished at some later date. The treatment of contusions of the nose chiefly consists of controlling hemorrhage. This can be accomplished by pinching the sides of the nose together for one half hour. If this procedure is not immediately and completely effective in stopping the flow of blood, there need be no great concern, since the bleeding will later stop spontaneously. Caution the patient not to blow his nose or otherwise disturb clots of blood.

MOUTH: *Open wounds* of the mouth usually heal without infection and residual disability and without special treatment. Mouth washes with sodium bicarbonate or normal saline may be used twice daily.

TEETH: *Fractured teeth* usually occur as a result of direct trauma. Broken or loose teeth, that are loosely connected with the gum, may be removed. Those which have a fairly firm attachment should be allowed to remain until the patient is able to consult a dentist. Fractured teeth with exposed nerves should be covered with a temporary filling made from zinc oxide and eugenol. Bleeding, following the loss of teeth, may be easily controlled by having the patient bite on a sterile pledget of gauze covering the bleeding area.

Pain associated with delayed healing after a tooth extraction (dry socket) may be relieved by packing the tooth socket loosely with sterile gauze saturated with eugenol. This packing should be changed daily.

JAW: *Dislocations* of the jaw occur infrequently but may be caused by a blow to the jaw or when the mouth is opened widely as in yawning. The chief symptom of such a dislocation is the inability of the patient to close his mouth. The dislocation may be difficult to reduce due to the spasm of muscles attached to the jaw. It may be possible for the Hospital Corpsman to reduce the dislocation by placing the two thumbs, wrapped with gauze to protect against being bitten, on the outer side of last teeth of the lower jaw and pushing downward as the fingers push up on the tip of the chin. An assistant can aid in this procedure by steadying the patient's head. After the dislocation has been reduced, advise the patient to avoid opening his mouth widely until the joint is no longer tender.

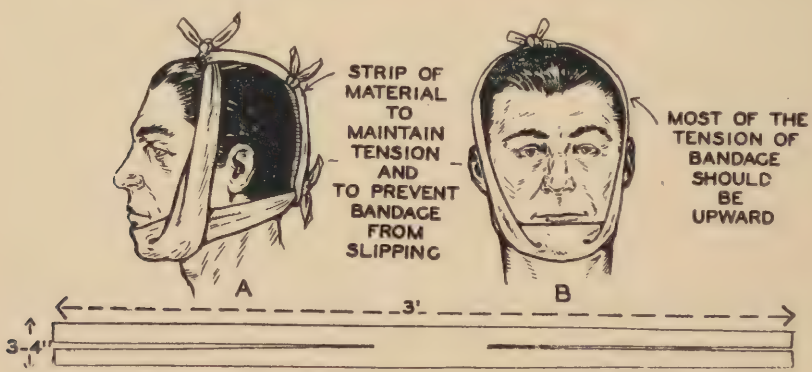


Figure 68. Application of four-tailed bandage to support a fractured jaw.

Fracture of the jaw is caused by a sharp blow to the mandible. The chief symptom of fracture of the mandible is pain increased by motion or pressure. Later, considerable swelling develops. Immediate treatment consists of immobilizing the lower jaw by applying a four-tailed bandage.

The patient should be given a liquid diet and referred to a dentist or a physician as quickly as possible.

Skull and Brain: *Skull fracture* is usually the result of a blow to the head. The fracture may occur at many different locations in the skull. Relatively few of these fractures, however, may be detected without the aid of an x-ray. Fractures in certain locations may be associated with the escape of cerebro-spinal fluid. This phenomenon may be noted by the appearance of a watery or a blood-tinged watery drainage from the nose or ear. Certain injuries that seem inconsequential may produce skull fracture.

The most important consideration following injuries to the head is not whether the skull is fractured, but *whether the brain is injured*. Brain injury is not always present with every skull fracture and brain injury may also occur without skull fracture. Brain injury may vary in degree from a mild contusion with extremely transitory stunning, to a severe laceration with immediate death. Mental dulling is the important sign of brain injury and extreme care should be exercised in the examination of a patient following a head injury to detect mild degrees of disorientation, apathy, loss of memory, incoherent speech, and inappropriate behavior. These symptoms may occur immediately following injury or be delayed in onset. They may be very transitory or quite persistent. They may vary in severity from extremely mild states to a complete loss of consciousness. In general, the degree of insensibility and the length of time this symptom persists is a good index of the degree of brain damage. Other symptoms that may be present with the more serious types of brain injury are temperature elevation, incontinence of urine or feces, slow and diminishing pulse rate, lowered blood pressure, and projectile vomiting.

Treatment is primarily directed toward rest of the patient, and for the safety of the patient it is better to keep him in bed for too long a period rather than too short a period. A good rule to follow is to keep the patient in bed one day for every minute of unconsciousness. Ice bags applied to the head will provide some relief from pain and headache. The more severe injuries will be associated with varying degrees of restlessness and delirium, and restraint of the patient may be necessary. In general, physical restraint tends to make the patient more restless and its use should be kept at a minimum. However, the patient must not be allowed to injure himself. Morphine should ordinarily not be used in the treatment of brain injury; however, the administration of barbiturates in small doses and half grain doses of codeine are permissible for the control of extreme restlessness. Fluid intake should be

kept at less than 1500 cc. daily for the first seventy-two hours or longer if necessary. The advice of a physician should be obtained as quickly as possible.

NECK

VERTEBRAE: *Fracture* of the vertebrae in the neck is a possibility in all severe injuries of the neck and should be suspected so that appropriate treatment may be given. Symptoms suggestive of a fractured neck vertebra are persistent pain, swelling, and unnatural position. If there is sufficient displacement of the bones to cause pressure on the spinal cord, varying degrees of paralysis and anesthesia may be present. Death often results from an injury of this extent. Treatment consists of immobilization of the neck with the head kept in the position in which it was found, and absolute rest in bed until a physician can assume the responsibility for the treatment of the patient. The head should be immobilized during transportation by an attendant who has no other duty to perform. Immobilization may be maintained, when the patient is placed in bed, by sandbags about the head and shoulders.

SOFT TISSUES: *Open wounds* of the neck are important in that they may involve special structures. Wounds in the anterior midline are apt to involve the trachea or larynx, in which case the entrance and exit of air through the wound with each respiration may be observed. A sterile dressing applied with slight pressure, and the observance of the usual precautions for the prevention of infection, are all that is necessary in this type of wound. Open wounds on either side of the trachea may involve the external jugular vein if they are relatively superficial. If the wound is deep, the internal jugular vein and carotid artery may be severed. In this last instance, the patient will probably bleed to death before the hemorrhage can be controlled. Direct digital pressure, followed by massive and very tight pressure dressings, may be lifesaving in these instances.

CHEST

RIBS AND CHEST WALL: *Severe contusions* of the chest are often associated with *rib fractures,* and a rib fracture should be suspected following injury to the chest in which there is localized pain, markedly increased in severity upon breathing. In the presence of such pain, the chest should be strapped with adhesive tape.

LUNGS: *Puncture wounds* of the chest cavity are prone to penetrate into the lung. Most of these wounds cause but minor injury to the lung and may be treated as an uncomplicated wound of the chest wall. The two common complications of penetrating chest injuries are bleeding

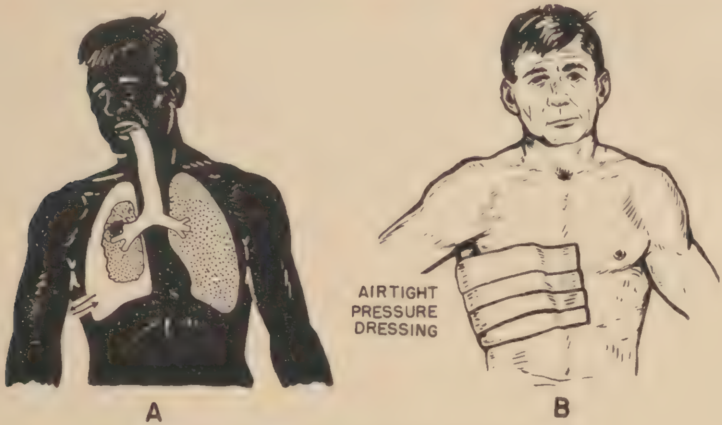


Figure 69. "Sucking wound" of the chest.

from the lung and pneumothorax. The signs and treatment of internal hemorrahge have been previously discussed. Traumatic pneumothorax results in the collapse of the lung due to the increase in inter-pleural pressure caused by the air sucked into the pleural space during respiration. Symptoms of this condition include rapid and extremely labored respiration, cyanosis, and shock. A wound into which air is obviously passing with each inspiration may be present (sucking wound). A wound of this type must immediately be closed if the life of the patient is to be preserved. This wound may readily be closed by manually shifting either of the skin edges well over the opening into the chest cavity. This procedure will allow the skin flap to act as a valve which will allow the escape of air from the chest cavity, but will prevent the entrance of air into the cavity. With the emptying of the air from the pleural space, the lung will re-expand and the symptoms will rapidly disappear. During this period it will be necessary to maintain the skin flap in its proper place by hand. The wound should then be hermetically sealed by the application of a thick pressure dressing applied to maintain the initial wound closure. Prophylactic administration of sulfonamides or penicillin should be instituted. The advice of a physician should be obtained as quickly as possible.

ABDOMEN

Severe contusions of the abdomen and flank are apt to result in a rupture of the solid organs lying beneath the site of injury. The most commonly injured are the liver, spleen, and kidneys. This type of injury is usually followed by shock and internal hemorrhage. Rupture or

laceration of a portion of the gastro-intestinal tract may also occur. These not only may be followed by signs of shock and hemorrhage but also, by evidence of severe infection of the peritoneal cavity. *Penetrating wounds* of the abdomen usually cause injury to underlying, internal structures. The penetration of the gastro-intestinal tract should always be considered as a probability following such an injury. Treatment is directed toward the control of shock and hemorrhage plus the prophylactic administration of sulfonamides and penicillin. The advice of a physician should be obtained as quickly as possible.

Strains of the muscles of the abdominal wall may occur following excessive muscular effort. They are characterized by the sudden appearance of pain during, or immediately after, strenuous muscular effort. This pain is followed by tenderness and stiffness of the affected muscles. If the condition is quite painful, the patient should be placed in bed and an ice bag applied to the tender area.

During muscular effort, pain and tenderness in the inguinal region may be noticed and upon examination, a protusion may be detected at or near the painful area. Such a condition is probably a hernia which was likely present but unnoticed prior to the muscular effort. This condition should be treated in the same manner as a strain of the muscles of the abdominal wall. The patient should avoid heavy lifting until he has been examined and advised by a physician.

EXTERNAL GENITO-URINARY ORGANS

Penis and Urethra: The most frequent injury to the penis and urethra is a *contusion.* This produces transitory but often severe pain and usually heals without residual damage. *Severe contusions, lacerations,* and *avulsions* may also occur. These injuries are likely to cause rupture of the urethra with extravasation of urine into the surrounding tissues with resultant superficial gangrene which will require major surgical treatment. These injuries may also be associated with marked bleeding which may be controlled by pressure dressings. The treatment of these severe injuries is the treatment of initial shock and severe hemorrhage; the maintenance of clean, dry dressings; and the control of infection through local and systemic measures. The advice of a physician should be obtained as quickly as possible. A traumatic rupture of the bladder causes an extravasation of urine into even more dangerous areas than does a rupture of the urethra, and in general, is treated in the same manner.

Occasionally a prepuce (foreskin) with a small orifice will be retracted behind the glans penis and the patient will be unable to return the

prepuce to its normal position (*paraphimosis*). The retracted prepuce acts as a constricting band around the penis and partially prevents the return flow of blood, which in turn causes a rapid swelling of the glans penis and a still tighter constriction. Reduction of this condition should be effected as quickly as possible. An early paraphimosis can easily be reduced by the following procedure. The constricting foreskin should be retracted still further until there are no overlapping folds. The swelling of the penis in front of the constricting band should be reduced as much as possible by squeezing the edema fluid under the constricting prepuce to the shaft of the penis. A small amount of petrolatum should be placed in the sulcus just behind the glans penis. The right hand should then grasp the penis over the constricting prepuce as near the glans penis as possible. The left hand should grasp the glans penis, and the glans penis should then be pulled forward and, simultaneously, the constricting foreskin rolled over it. Attempts at reduction of a paraphimosis before the edema has been manually expressed will prove futile. If this procedure is not sucessful, the advice of a physician should be obtained as soon as possible.

TESTICLE*:* The most common injury of the scrotum and testicle is a mild *contusion* which is extremely painful and often produces mild and very transitory shock-like symptoms. These injuries require no treatment. *Severe crushing* and *tearing injuries* of the scrotum and its contents should be treated by the control of shock and hemorrhage, by adequate support of the injured organs (usually requiring bed rest), and the prevention of infection by local and systemic means depending on the nature of the injury.

Painful swellings of the scrotum which are of infectious origin, are very often confused with traumatisms. This probably results from the patient's reticence to face the venereal aspects of his condition. Thorough questioning will usually bring out a history of gradual onset, a history of gonorrhea, and a history of very minimal trauma, if any. This history of trauma usually consists of pain following lifting. These patients require support of the scrotum and the administration of the sulfonamides or penicillin.

BACK

Pain in the back following exertion is a frequent complaint. This symptom often results from injury to the back muscles, tendons, and ligaments. Most of these injuries are mild and require no treatment. The application of heat, liniments, massage, and the oral administration of aspirin promote comfort. *Severe strains and sprains* will require

rest on a hard, flat bed (boards under the mattress), in addition to the above measures.

VERTEBRAE: *Fractures* of the back are caused by the same types of injuries producing fractures of the neck. As is true in fractures of the neck, many of these fractures can only be detected by x-ray examination; but in other instances there may be displacement of the vertebrae and pressure on the spinal cord with consequent anesthesia and paralysis, and at times, immediate death. Treatment is the same as that outlined for fractures of the neck.

UPPPER EXTREMITY

CLAVICLE: The prominence of the clavicle increases its possibility of fracture. *Fractures* of the clavicle are associated with pain at the site of injury and, generally, deformity. The characteristic attitude of such an injured person is one of sagging of the shoulder with the patient supporting the weight of the affected shoulder with his unaffected arm. An examination of the clavicle reveals a shortening of the bone with swelling and deformity over the site of the injury. Treatment is directed toward the relief of pain, reduction and immobilization of the fracture. This may be accomplished by the application of a **T** splint or a figure of **8** bandage of the shoulders.

SHOULDER: An injury to the shoulder which results in complete loss of function is more apt to be a *dislocation* than a fracture. The characteristic attitude of a patient with a dislocated shoulder is one of a sagging shoulder with the elbow held away from the body and the hand and forearm turned outward. There is extreme pain in the shoulder region and no motion in the shoulder joint. The injured extremity is supported by the unaffected one. The head of the humerus may often be palpated in an abnormal position. Treatment of this injury is directed toward the relief of pain, which in most instances requires morphine, and the reduction of the dislocation. The reduction of recurrent dislocations and many initial dislocations, if performed immediately after injury, may be accomplished with considerable ease. Dislocations allowed to remain unreduced for more than a short period of time will be followed by marked muscular spasm. The reduction of these dislocations may best be accomplished by straight-arm traction. Following the reduction of the dislocation, the extremity may be supported and immobilized by a Velpeau bandage, which should be left in place for one week. Other severe injuries to the shoulder may be treated by the application of a Velpeau bandage, while still others

will require bed rest and immobilization of the shoulder with pillow splints.

Elbow: Severe injury to the region of the elbow joint usually results in *fracture* rather than dislocation. These injuries are characterized by severe pain, loss of function, and abnormal relationship of bony prominences. Treatment of these injuries is directed toward the relief of pain and toward immobilization. Morphine will usually be required and immobilization may be obtained by bandaging and splinting the extremity so that the elbow is flexed to approximately 30°. Fractures of the olecranon process (tip of the elbow) should be splinted in full extension rather than flexion.

Wrist: Severe injuries around the wrist joint usually result in *fractures,* particularly when produced by a fall on the outstretched arm. These fractures are characterized by pain and the characteristic "silver fork" deformity if a Colle's fracture has been produced. This deformity appears as an abnormal elevation at the wrist so that the profile of the wrist resembles the profile of a table fork. Fractures of the carpal bones, particularly in younger persons, may be caused by a similar fall. These fractures are characterized by severe pain and swelling but have no characteristic deformity. Treatment of these injuries is directed toward the relief of pain and swelling and the immobilization of the part by the application of well-padded wood or wire splints. Care must be exercised not to apply constricting dressings.

Hands and Fingers: *Fractures* of the metacarpal and phalangeal bones usually result from direct impact and may be recognized by the associated severe injury to the soft tissues and characteristic deformity of the bone. Small chip fractures and linear fractures may occur without associated severe soft tissue injury, but cannot be recognized without x-ray examination and usually heal without significant, residual dysfunction. Treatment of fractures of the fingers and hands is directed toward the relief of pain, reduction of swelling, treatment of the soft tissue injury, and the immobilization of the injured bone with the hand and fingers fully extended. *Dislocations* of the fingers are usually caused by blows striking the tips of the fingers and are characterized by pain and locking of the joint in an abnormal position. These dislocations may be reduced by pulling on the end of the finger. Following reduction, the finger should be splinted in an extended position for one week. Fractures are frequently associated with such dislocations and considerable degrees of residual tenderness existing one week after the injury suggest such a possibility.

Open wounds of the hands and fingers are important because of tendon injury and the great hazard of infection. Injury to a tendon is characterized by an absence of normal motion. Examination to determine normal motion should be made following such injuries. Infections of the deeper structures of the hand are extremely important since they tend to spread rapidly along the tendon sheaths. These infections are not only dangerous to life, but may cause an extreme degree of crippling. If an injury to one or more of the flexor tendons of the finger is detected, the hand should be bandaged and maintained in a position midway between flexion and extension. If evidence suggests severance of an extensor tendon, the hand and fingers must be maintained in a position of full extension.

In the presence of deep puncture wounds or severe lacerations, these wounds should be considered as already infected and treated with hot, wet compresses and the administration of sulfonamide drugs or penicillin.

LOWER EXTREMITY

HIP: Severe injuries to the region of the hip usually produce a *fracture* of the upper end of the femur (fractured hip). These fractures usually occur in older people following a fall in which they strike the hip, or following a direct blow to that region. These fractures are characterized by severe pain, shortening of the extremity, and the outward rotation of the injured extremity. Treatment is directed towards the control of pain and shock, and fixation of the extremity without attempts at reduction. Fixation in bed may be most readily achieved by the use of sandbags.

KNEE: Most of the injuries around the kneejoint fall in the category of *sprains* and *injuries to joint cartilage*. Many of these injuries are recurrent in nature. Treatment is the same as for sprains in other parts of the body. Direct blows to the patella (kneecap) may cause its *fracture* which is characterized by fragmentation or separation of the bone, readily palpated if examination is made immediately following the injury. Marked swelling will quickly obscure these findings. Treatment consists of the relief of pain and swelling, and immobilization of the lower extremity with the knee fully extended. Fractures of the bones comprising the knee joint and dislocations of this joint occur infrequently, and are usually the result of extremely powerful forces. These injuries are treated in accordance with general principles outlined elsewhere. Marked soft swellings in front of the knee ("water on the knee", "housemaid's knee") occur as a result of *injury to the prepatellar bursa*. Bursae are sac-like cavities, filled with viscid fluid,

located near joints and are designed to prevent friction from the action of muscles and tendons. Injury to these organs produces tenderness and excessive quantities of fluid. This is particularly prone to occur following repeated minor trauma. Traumatic inflammations of bursae frequently occur at the elbow and shoulder joints. Treatment consists of rest and the application of heat if the condition is severe. If the condition is not painful, treatment may be safely delayed until the patient can be placed under the care of a physician.

ANKLE: *Sprains* of the ankle are quite frequent occurrences and usually follow sudden twisting injuries. Many of these injuries are associated with chip fractures which may be detected only by x-ray examination. Ankle sprains are characterized by varying degrees of pain, swelling, discoloration, and limitation of function as a result of pain and swelling. Treatment consists of attempts to reduce swelling, rest, and immobilization. Severe injuries will require bed rest with the foot elevated and the application of cold, followed by strapping or bandaging of the foot in a position of eversion and dorsal flexion. Mild injuries of this type may require only strapping or no treatment at all.

FOOT: *Fractures* of the foot usually occur following crushing injuries with the exception of fractures of the os calcis (heel bone) which occur as a result of a direct blow, usually from a fall. Fractures of the os calcis and other tarsal bones are characterized by marked pain on attempting to walk and should be treated by rest in bed with the foot elevated. Fractures of the metatarsal and phalangeal bones are usually adequately splinted by the foot structure. They are further protected by the stiff sole of the shoe and if the patient walks without bending his foot, he may be able to walk on his injured foot without much discomfort. If there is considerable soft tissue injury, the patient should be treated by bed rest and appropriate care of the soft tissues. A shoe in which the sole has been reinforced and the upper cut away, so as to prevent pressure at the site of the injury, will provide an excellent splint for these fractures.

Chapter VI

PROCEDURES

APPLICATIONS, LOCAL; COLD, DRY

PURPOSE

1. To relieve pain and promote comfort.
2. To assist in the control of hemorrhage.
3. To help reduce an elevated temperature.
4. To aid in the prevention of swelling following injury.

MATERIALS

1. Icebag with cloth cover.
2. Basin with small pieces of ice.

PROCEDURE

1. Test the ice bag for leaks.
2. Fill the ice bag about one half full of ice.
3. Expel excess air from the bag by pressing the upper surface close to the ice chips. Screw in the cap tightly.
4. Turn the bag upside down to check for leaks around the cap.
5. Cover the bag and place it on the patient.
6. Refill the bag with ice as often as necessary to keep it cold.

PRECAUTIONS

1. Be sure that the bag does not leak.
2. Never place an uncovered ice bag on a patient.
3. Change the cover on the bag as often as necessary to prevent it from becoming moist.
4. Remove the ice bag every two hours for fifteen minutes.

APPLICATIONS, LOCAL; COLD, WET, INTERMITTENT COMPRESSES

PURPOSE

1. To reduce swelling and congestion.
2. To relieve pain and promote comfort.

MATERIALS

1. Gauze compresses, 4 x 4. Small towels may be substituted for compresses.

2. Small basin of boric acid solution or tap water.
3. Basin of chipped ice.
4. Towels and rubber sheeting to protect the patient and the bed.

PROCEDURE

1. Wash hands.

2. Assemble equipment. The materials should be scrupulously clean but need not be sterilized.

3. Place the smaller basin of solution inside the basin of chipped ice. Allow the solution time to cool.

4. Place the gauze compresses in the basin of solution.

5. Protect the bed and the patient with the rubber sheeting and towels.

6. Wring excess solution out of the compresses and apply to the affected area.

7. Change each compress as it becomes warm. It will be necessary to change the compress every minute or oftener.

8. This treatment is usually continued for a period of twenty minutes and repeated every two or three hours. Most patients will be able to apply their own compresses after brief instructions.

9. Clean, sterilize, and store non-perishable equipment.

PRECAUTION

When treating an infected eye, always protect the unaffected eye with a shield during the treatment.

APPLICATIONS, LOCAL; HOT, DRY

PURPOSE

1. To stimulate circulation.
2. To promote comfort and relieve pain.

MATERIALS

1. Hot water bag with cloth cover.
2. Hot water at 120°F. (49°C.).

PROCEDURE

1. Test the hot water bag for leaks.

2. Fill the bag one half full of hot water.

3. Expel all air from the bag by placing it on a flat surface and pressing the lower half until the water appears at the neck of the bag. Screw in stopper.

4. Turn the bag upside down to check for leaks around the stopper.
5. Cover the bag and place it on the patient.
6. Change the water in the bag as often as necessary to keep it hot.

PRECAUTIONS

1. Be sure the bag does not leak.
2. Always test the temperature of the water to avoid extreme heat and subsequent burns.
3. Never place an uncovered hot water bag on a patient.
4. Never place a hot water bag in the bed with an unconscious patient.

APPLICATIONS, LOCAL; HOT SOAKS

PURPOSE

1. To stimulate circulation.
2. To relieve congestion.
3. To promote comfort and relieve pain.

MATERIALS

1. Tub or basin large enough to allow complete immersion of the part.
2. Solution at 110° F. (43° C.): normal saline solution, magnesium sulfate solution 20%, boric acid solution 4%, or other medicated solutions.
3. Two bath towels.

PROCEDURE

1. Assemble equipment. The materials should be scrupulously clean but need not be sterilized.
2. Place the patient in a comfortable position before beginning the treatment.
3. Fill the tub with enough solution to completely cover the affected area.
4. Gradually immerse the extremity in the solution.
5. As the solution cools, gradually add more hot solution.
6. This treatment is usually continued for twenty to thirty minutes and repeated three times daily.
7. At the conclusion of the treatment, remove part from the hot bath and dry with a bath towel.
8. Apply dressing if indicated.
9. Clean, sterilize, and store non-perishable equipment.

PRECAUTIONS

1. Always immerse the part gradually into the hot solution to accustom the patient to the heat.

2. When adding more hot solution, place your hand between the affected part and the stream of solution to prevent burning the patient.

APPLICATIONS, LOCAL; HOT, WET, CONTINUOUS COMPRESSES

PURPOSE

1. To localize inflammation.
2. To relieve pain and promote comfort.

MATERIALS

1. Gauze leg roll. Fluffed gauze or towels may be substituted.
2. Piece of oiled silk large enough to cover the dressing. Thin rubber sheeting, oilcloth, or canvas may be substituted.
3. Large bath towel.
4. Hot water bag containing water at 120°F. (49°C.).
5. Basin of solution: boric acid solution 4%, magnesium sulfate solution 20%, or tap water.
6. Electric hot plate.
7. Lubricant for the skin.

PROCEDURE

1. Wash hands.
2. Assemble equipment. The articles must be scrupulously clean but need not be sterilized.

3. Heat the solution to approximately 120°F. (49°C.).

4. Place gauze fluffs or leg roll in the basin of solution.

5. Apply a thin coating of lubricant over the area to which the dressing is to be applied. Do not lubricate open lesions.

6. Remove the dressing from the solution. Wring excess solution out of leg roll and bandage the affected area very loosely. The dressing should extend well above and below the inflamed area.

7. Cover the dressing with the oiled silk to protect the bedclothes. Tie securely in place with strips of bandage.

8. Place the hot water bag outside the oiled silk to maintain the heat in the dressing.

9. Wrap the part in a large bath towel to hold the hot water bag securely in place.

10. Remove the towel, hot water bag, and oiled silk every three hours to moisten the gauze with fresh hot solution.

11. Refill the hot water bag every hour to keep the dressing hot.

12. Clean, sterilize, and store all non-perishable equipment.

PRECAUTIONS

1. Always lubricate the area before applying the hot wet dressing. A thin coating of oil will prevent skin irritation from the constant moisture. It will also prevent "water-logging" of the tissues and burning.

2. Be sure the dressing is kept hot at all times.

3. Apply the hot water bag over the rubber sheeting. Be sure the bag does not touch an exposed part of the patient's body because of the danger of burning him.

4. Apply the leg roll very loosely to prevent pressure over the area or cutting off circulation.

APPLICATIONS, LOCAL; HOT, WET, INTERMITTENT COMPRESSES

PURPOSE

1. To apply moist heat to areas where a continuous wet dressing is impossible or inadvisable.

2. To stimulate circulation.

3. To relieve inflammation.

4. To relieve pain.

MATERIALS

1. Gauze compresses, 4x4. Small towels or pieces of flannel may be substituted for compresses.
2. Small basin with solution: boric acid solution 4% or tap water.
3. Lubricant for the skin.
4. Electric plate.
5. One bath towel and rubber sheet.

PROCEDURE

1. Wash hands.
2. Assemble equipment. The materials should be scrupulously clean but need not be sterilized.
3. Heat the solution to approximately 120°F. (49°C.).
4. Place the compresses in the basin of solution.
5. Protect the patient and the bed with rubber sheet and towel.
6. Apply a liberal coating of lubricant to the skin.
7. Wring the excess solution from the compresses and apply to the affected part.
8. Change each compress as it becomes cool. It will be necessary to change the compress every minute or oftener.
9. This treatment is usually continued for a period of twenty minutes and repeated every two or three hours. Most patients will be able to apply their own compresses after brief instruction.
10. Clean, sterilize, and store all non-perishable equipment.

PRECAUTIONS

1. When treating an infected eye, always protect the unaffected eye with a shield during the treatment.
2. Apply compresses gradually to accustom the skin to the heat and avoid burning.

ARTIFICIAL RESPIRATION; EVE'S ROCKING METHOD, APPLICATION OF

PURPOSE

To encourage the resumption of normal breathing in an individual whose respiration is weak or has apparently ceased, when injuries prohibit the use of other methods.

MATERIALS

1. Any long, flat object, such as a rigid stretcher (Stoke's litter or Army litter), wide board, or oars tied together, of sufficient length and width to support patient.
2. Four triangle bandages.
3. Pivot point, such as a saw horse, overturned lifeboat, or guard rail.

PROCEDURE

1. Place patient in position (prone or supine position is optional, however, the preference is prone) and turn head to one side. The arms should be extended over the head and if patient is in prone position, place one hand under the patient's cheek.
2. Secure the arms and legs to the stretcher or other object to prevent the patient from slipping.
3. Have assistant stationed at other end of stretcher and alternately elevate and lower each end of stretcher to approximately a 45° angle. Maintain a rhythm of 15 complete cycles per minute.
4. Continue procedure until breathing is adequately established or until the futility of the procedure is apparent.

PRECAUTIONS

1. Maintain one continuous sweeping motion of elevation and lowering. Do not pause at the halfway mark.
2. Due to time loss in preparation, this procedure is best suited as an auxiliary to the Schaefer Prone Pressure Method.

ARTIFICIAL RESPIRATION; LIFEBOAT METHOD, APPLICATION OF

PURPOSE

To encourage the resumption of normal breathing when respirations are weak or apparently absent, where space and facilities do not warrant the use of other conventional methods.

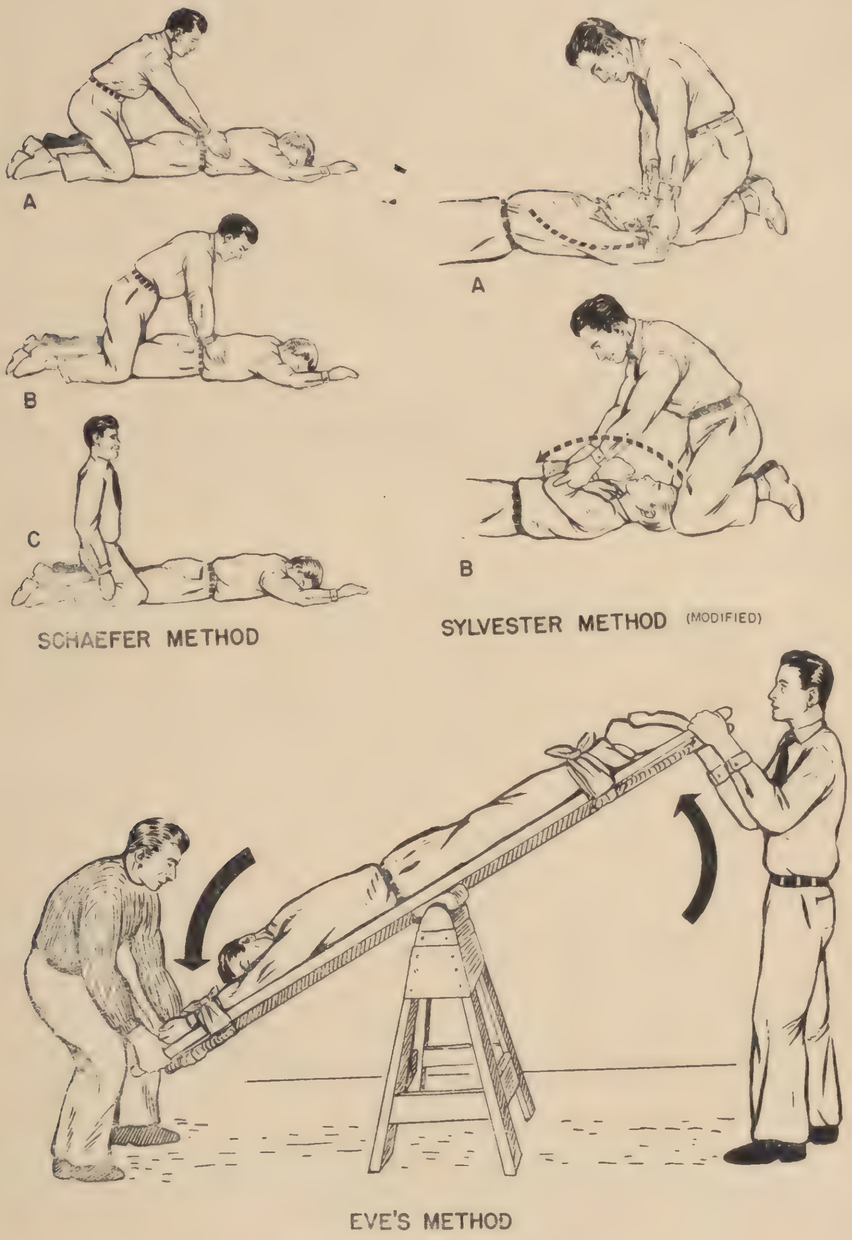


Figure 70. Artificial respiration.

PROCEDURE

1. Operator sits on deck of boat or raft with legs extended and spread apart.

2. The patient is placed in a sitting position directly in front of operator with extended legs and with his back to the operator.

3. The operator reaches around the patient's waist with both arms and clasps his hands together over the lower abdomen of the patient.

4. The operator then squeezes the patient's abdomen, directing the pressure upward to the patient's chest. Release of the pressure causes inhalation of air.

5. Regulate procedure to a rhythm of 15 per minute.

PRECAUTIONS

1. Cease procedure only when adequate breathing has begun or the futility of the procedure is demonstrated.

2. Check patient's mouth and nose for respiratory obstruction.

ARTIFICIAL RESPIRATION; SCHAEFER PRONE PRESSURE METHOD, APPLICATION OF

PURPOSE

To encourage the resumption of normal breathing in an individual whose respiration is weak or has apparently ceased.

MATERIALS

Two blankets, if available.

PROCEDURE

1. Place the patient on blanket in the prone (face down) position and turn his head to one side, resting the cheek on the hand of the same side.

2. Kneeling, straddle one or both legs of the patient.

3. Extend arms and place hands on both sides of the chest with the fingers and thumbs approximated and the little finger of both hands over the last floating rib of the patient.

4. Rocking forward at the knees, with the elbows held straight, transfer weight to the patient's chest. Continue movement until hands and shoulders are in a vertical line.

5. Release pressure on the ribs and return to original position, with buttocks resting on heels.

6. Repeat procedure, counting as follows:
    1. Place hand on ribs.
    2. Transfer weight to patient's chest.
    3. Release pressure.
    4. Return to original position.

Each complete count of four should take approximately four seconds.

7. When breathing is adequately resumed, discontinue procedure.

PRECAUTIONS

1. Always consider the cause of respiratory failure and check for respiratory obstruction of the mouth or nose.

2. If necessary, cover patient with blanket to conserve body heat.

3. Never apply too sudden, too heavy, or too sharp pressure to the chest of the patient as this may cause injury to underlying structures.

4. If relief of the operator is necessary, this should be accomplished without disturbing the rhythm and timing of the procedure.

5. Cease procedure only when the patient is breathing adequately or when no doubt exists as to the futility of the procedure.

ARTIFICIAL RESPIRATION; SYLVESTER METHOD (MODIFIED), APPLICATION OF

PURPOSE

To encourage the normal resumption of breathing when respirations are weak or apparently absent and when injuries to the abdomen prohibit the use of other methods.

MATERIALS

Two blankets, if available.

PROCEDURE

1. Place patient flat on back on blanket with face turned to one side and with arms lying at sides. Cover lower part of body with blanket to preserve body heat.

2. Kneel, straddling the patient's head and facing his body.

3. Grasp the patient's arms at the elbow joints. Flex forearms to 45° angle.

4. Rotate patient's arms toward his head, keeping his arms parallel with the deck until they are at right angles to the body.

5. Pause for about two seconds.

6. Return arms to side, using same rotary motion and apply pressure to the chest, in the absence of chest injury.

7. Repeat procedure, maintaining a rhythm of 15 cycles per minute.

PRECAUTIONS

1. Check patient's mouth and nose for respiratory obstruction.

2. To secure maximum effect, maintain rotating arms as nearly parallel to the deck as possible.

3. Continue efforts until adequate breathing is established or until the futility of the procedure is demonstrated.

BANDAGING, APPLICATION OF

General Rules

PURPOSE

1. To keep dressings or splints in place.
2. To immobilize or support an injured part.
3. To apply pressure.

TYPES

1. Roller bandage:
   - Gauze.
   - Muslin.
   - Flannel.
   - Elastic.
2. Triangle bandage.
3. "Tailed" bandage.

PROCEDURE

1. Make the patient as comfortable as possible and place him in such a position that the bandaging may be applied without excessive bending or stretching on the part of the operator.

2. Place the part to be bandaged in such a position that all points are readily accessible, but at the same time provide adequate support.

3. Remove sufficient clothing to adequately expose the part.

4. Be sure that a sufficient quantity of bandage of the correct length, width, and type is available for the procedure.

5. Apply bandage with firm and even tension, but do not unduly constrict the part.

6. Leave tips of fingers or toes exposed, if possible, to check for adequate circulation.

7. Allow for possible swelling. Elevation of the part will often reduce or prevent swelling.

8. Do not tie knots over bony prominences or at any other location where the pressure of the knot may produce undesirable results.

9. Roller bandages should be firmly anchored and applied so that each turn overlaps the preceding turn by ½ to ¾ its width.

10. Roller bandages should lie flat with no wrinkles or unintentional folds. Wrinkling is usually caused by the use of too wide a bandage.

11. The skin should not be exposed between roller bandage turns, nor should the skin be pinched between turns. This is commonly caused by using too narrow a bandage.

12. Roller bandage should be applied from the distal toward the proximal point of any extremity.

13. Bandages should be applied so that all adjacent skin surfaces are separated.

14. Be sure that the bandage is tied in such a manner that it will not come loose.

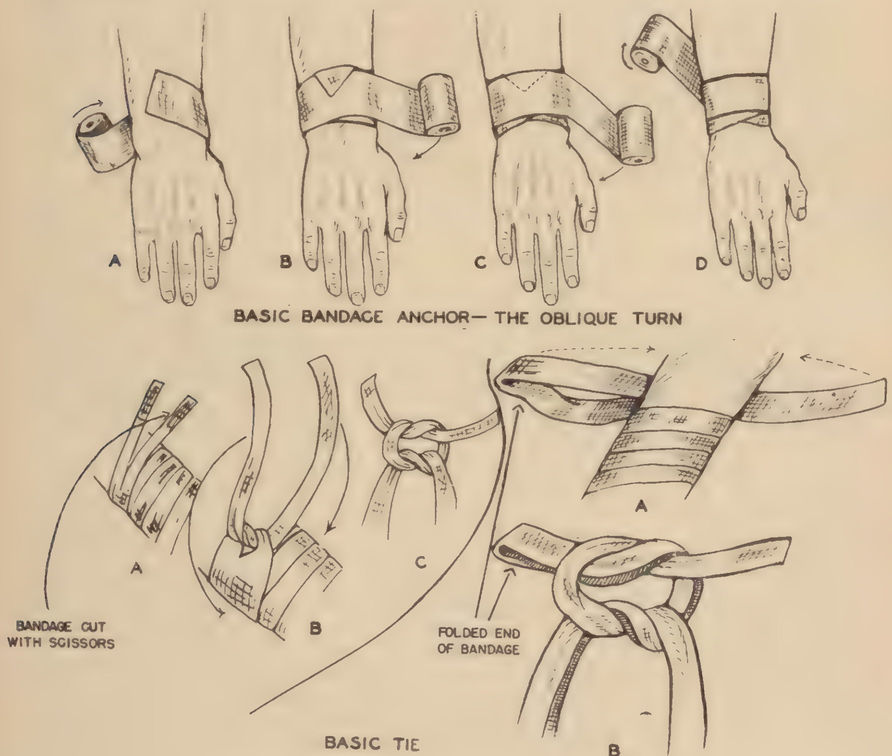


Figure 71. Methods of securing roller bandage.

PRECAUTIONS

1. Be sure that the purpose for which the bandage is applied is achieved.

2. Check injured part for adequate circulation periodically.

3. Investigate patient's complaints concerning uncomfortable bandage.

BANDAGING; CIRCULAR TURN, APPLICATION OF

PURPOSE

1. To anchor a bandage.
2. To cover a small area.

MATERIALS

Gauze, flannel, muslin, or elastic bandage of appropriate widths.

PROCEDURE

1. Place the end of the bandage on the part to be covered and encircle the part with a sufficient number of turns to cover the area.

2. These turns may be spread out somewhat in order to cover the desired area.

PRECAUTIONS

(See General Rules of Bandaging)

BANDAGING; EYE OR EAR, APPLICATION OF

PURPOSE

To secure a dressing to, or to provide an absorbent cover for the eye or ear.

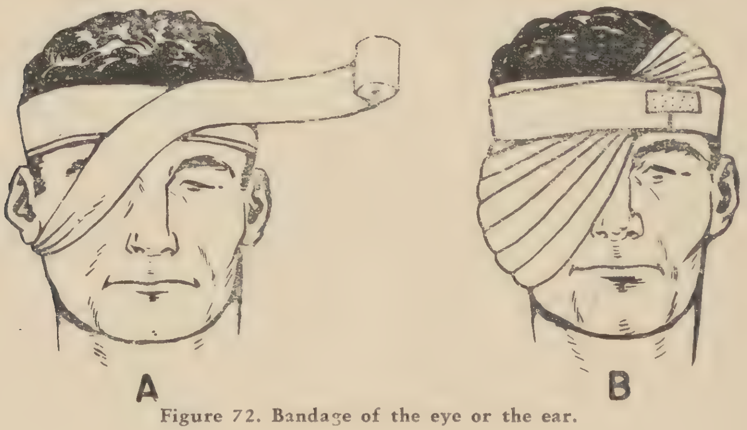


Figure 72. Bandage of the eye or the ear.

MATERIALS

Gauze roller bandage, 2 inches wide.

PROCEDURE

(EYE)

1. Anchor bandage around the head with two circular turns. The lower border of the bandage should be just above the level of the eyebrows.

2. Carry bandage over the back of the head, below occipital bulge and then bring forward under the ear of the injured side.

3. Carry bandage diagonally up across the cheek, over the eye and bridge of the nose to the forehead.

4. Carry bandage over unaffected side of head slightly higher than the circular anchoring turns.

5. Repeat procedure, carrying each turn higher over the cheek and eye and progressively lower on the side of the head.

6. Secure bandage by tying or by fixation with adhesive tape.

PROCEDURE
(EAR)

1. Perform same procedure as for the eye, but with the bandage turns higher and not covering the eye.

PRECAUTIONS

1. Maintain smooth even tension throughout the procedure to secure best bandaging results.

2. Place padding behind the ear to prevent distortion and resultant pain.

BANDAGING; FIGURE OF 8, APPLICATION OF

PURPOSE

To support and partially immobilize a joint.

MATERIALS

Two inch gauze, flannel, muslin, or elastic roller bandage.

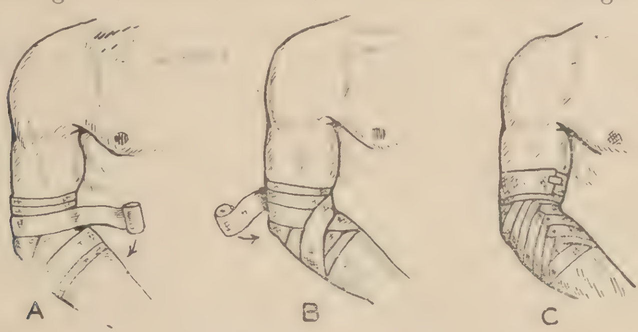


Figure 73. Figure of 8 bandage of the elbow.

PROCEDURE

1. Flex the extremity to form a right angle.
2. Anchor bandage below the joint with two circular turns.
3. Bring third turn directly over the prominence of the joint.

4. Anchor bandage above the joint with two circular turns.

5. Bring bandage down over the joint and circle part below the joint, overlapping previously applied bandage by 2/3 of the bandage width, working toward the joint apex.

6. Bring bandage back up over the joint and circle the part above the joint, overlapping previously applied bandage by 2/3 of the bandage width, working toward the joint apex.

7. Proceed with succeeding turns and overlap each preceding turn by 2/3 the bandage width, having all turns converge in the hollow of the joint being bandaged.

8. Secure bandage above joint with a circular turn and by tying or the use of adhesive tape.

PRECAUTIONS

1. Keep joint flexed at all times during the application of the bandage.

2. Full flexion of the part should not restrict circulation and full extension of the joint should cause only a moderate amount of loosening of the bandage.

BANDAGING; GAUNTLET, APPLICATION OF

PURPOSE

To cover the entire hand and each finger separately in order to provide motion of each part, if desired.

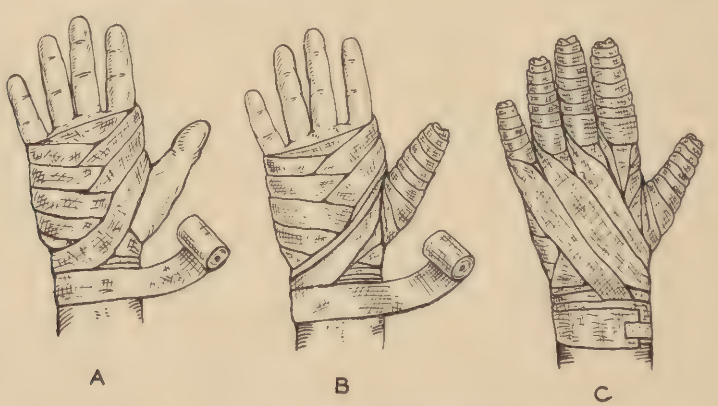


Figure 74. Gauntlet bandage.

MATERIALS

Three rolls of 1 inch gauze, muslin, flannel, or elastic roller bandage.

PROCEDURE

1. Anchor bandage at wrist with two circular turns.

2. Cover hand with figure 8 bandage.

3. When hand bandage is complete, cover each finger with a simple recurrent bandage, making a circular turn around the wrist after bandaging each finger.

4. Secure bandage by tying or fixation with adhesive tape.

PRECAUTION

Maintain uniform, non-constricting tension throughout the application of the bandage.

BANDAGING; RECURRENT, APPLICATION OF

PURPOSE

To cover terminal points of the body such as the head, hand, finger tips, toes and stumps of parts following traumatic amputation.

MATERIALS

1. Gauze, flannel, muslin, or elastic roller bandage of sufficient length.

Head	2 inch width
Hand	2 inch width
Fingers and toes	1 inch width
Stumps	dependent upon area involved

2. Adhesive tape of sufficient widths and lengths for securing completed bandage.

PROCEDURE

(SINGLE RECURRENT OF THE HEAD)

1. Anchor bandage with two circular turns around the head starting posteriorly at the middle of the base of the occipital bone.

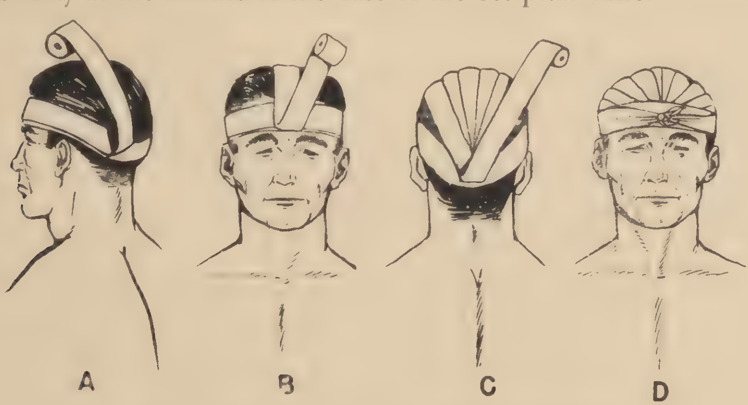


Figure 75. Single recurrent bandage of the head.

2. At the completion of the second turn, reverse the direction of the bandage to a right angle to the previously applied bandage and carry up to and across the superior midline of the head to the center of the forehead.

3. Bring bandage back over the top of the head to its starting point, overlapping previously applied bandage by ½ the bandage width.

4. Repeat procedure and each time overlap previously applied bandage by ½ the bandage width. Alternate on each side of the original turn until recurrent bandage turns fall directly over the circular anchor turns above the ears.

5. Complete bandage with two circular turns and secure by fixation with adhesive tape.

PRECAUTIONS

1. Extend bandage well down to the eyebrows and base of the skull.

2. Each recurrent turn must extend the full length from the base of the occipital bone to directly above the eyebrows. If this rule is not observed, they will not be held by the two final, anchoring, circular turns.

3. Assistance will be needed to hold the recurrent turns tight and in place during procedure.

PROCEDURE

(RECURRENT FOR FINGER, TOE OR STUMP)

1. Anchor bandage at the base of the part with two circular turns, and reverse bandage at right angles to previously applied turns.

2. Carry bandage up to and across the distal point of the part, and down to the circular turns on the other side.

3. Bring bandage back over the distal point of part and down to original starting point.

4. Repeat procedure until sufficient coverage of the distal point of the part is obtained, fanning out recurrent turns as they are made.

5. Start at distal point of the part and gather in the edges of the recurrent turns with spiral turns, which continue to the base of the part.

6 Anchor bandage at base of the part with two circular turns and secure by tying or fixation with adhesive tape.

7. Reinforce the bandage with strips of adhesive tape.

PRECAUTION

Since the part is completely covered by bandage, care must be observed to avoid circulatory obstruction by undue constriction.

BANDAGING; SPICA OF THE SHOULDER OR HIP, APPLICATION OF

PURPOSE

To support and partially immobilize a joint difficult to bandage because of the contour of the joint and the motion involved.

MATERIALS

Three-inch gauze, muslin, flannel, or elastic roller bandage of sufficient length.

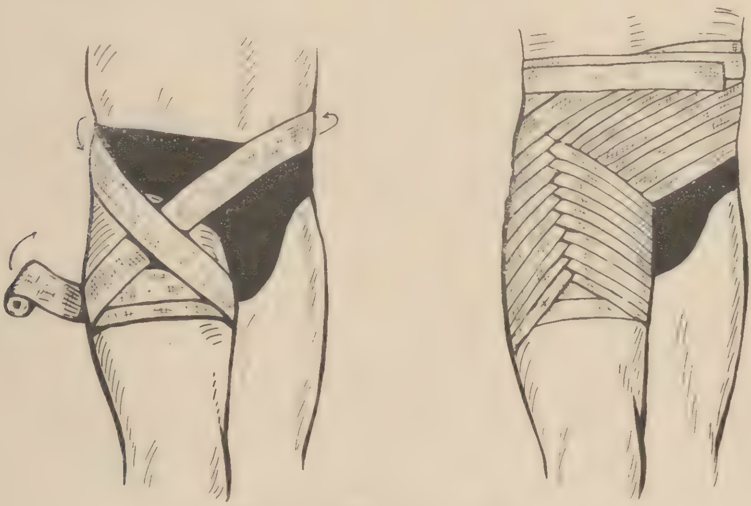


Figure 76. Spica of the hip.

PROCEDURE

1. Anchor bandage, close to the attachment of the extremity to the trunk, with two circular turns.
2. Bring third turn of the roller bandage up and diagonally across the extremity to the trunk.
3. Circle bandage completely around the trunk and bring diagonally down and across the extremity to starting point.
4. Circle extremity, overlapping previously applied bandage by 2/3 of its width, and repeat procedure working up to the apex of the joint.
5. Secure bandage by tying or fixation with adhesive tape.

PRECAUTIONS

1. The crossing of the bandage should be over the area where pressure is desired and may be placed anteriorly, laterally, or posteriorly.
2. Pad axilla or groin if bandage is to be worn for any length of time.

BANDAGING; SPIRAL REVERSE, APPLICATION OF

PURPOSE

To cover a tapering part of the body.

MATERIALS

Gauze, flannel, muslin, or elastic roller bandage of sufficient width and length.

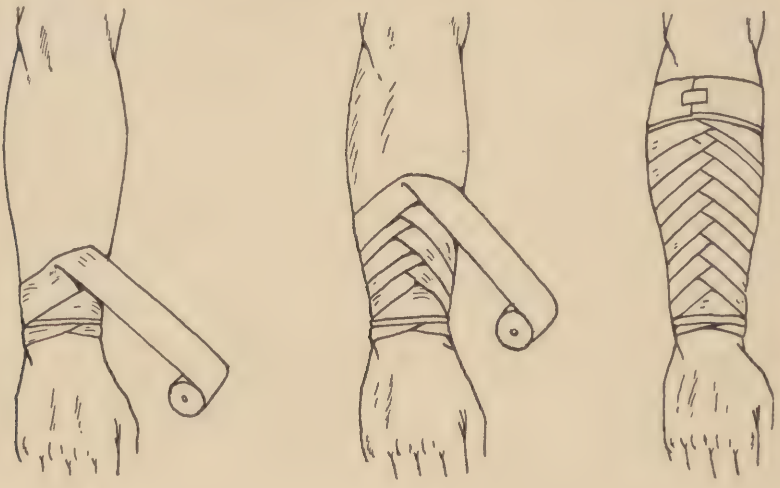


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Figure 77. Spiral reverse bandage applied to the forearm.

PROCEDURE

1. Anchor bandage with two circular turns at the smallest diameter of the part to be bandaged.

2. Angle the third turn so that the edge of the bandage falls in the center of the previous circular turn.

3. The thumb of the free hand is placed flat against the last spiral to retain proper tension. The hand holding the roll of bandage should relax the tension. By a twist of the wrist bring the top edge of the bandage toward the operator in a complete half circle. Resume tension on the bandage and proceed around the part, repeating the process with each turn until the desired area is covered.

4. Fasten bandage by tying or with adhesive tape.

PRECAUTIONS

1. The thumb of the free hand determines the placement of the reverse.

2. Always relax the tension on the bandage when making the reverse or wrinkling will result.

3. Each overlapping should be evenly spaced, preceding the spiral reverse.

4. The reverses should be in a straight line and over fleshy part of extremity.

BANDAGING; SPIRAL TURN, APPLICATION OF

PURPOSE

To cover moderately large, uniformly cylindrical parts of the body.

MATERIALS

Gauze, flannel, muslin, or elastic roller bandage of appropriate width.

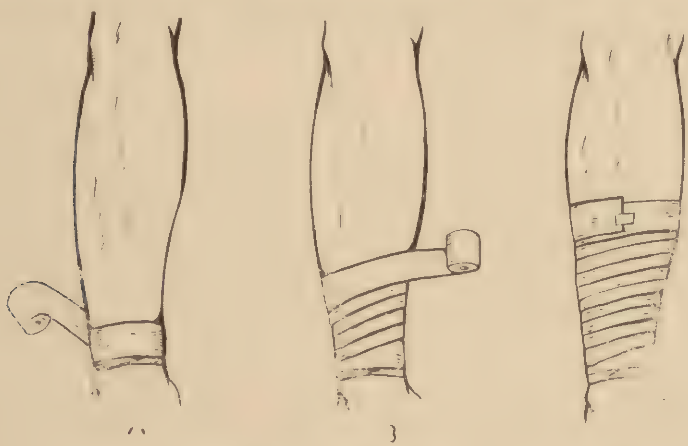


Figure 78. Simple spiral bandage applied to the forearm.

PROCEDURE

1. Anchor the bandage distal to the area to be covered by one or two circular turns.
2. Change the angle of bandaging so that each turn overlaps the previous turn about one half.
3. Repeat the turns until the desired area is covered.
4. Secure by tying or with adhesive tape.

PRECAUTION

If the area to be bandaged is near a moving part, the overlapping should be about 2/3 of the previous turns.

BANDAGING; TRIANGLE BANDAGE OF THE HAND OR FOOT, APPLICATION OF

PURPOSE

To provide an emergency covering or to retain a dressing in place on the hand or foot.

MATERIAL

Triangle bandage.

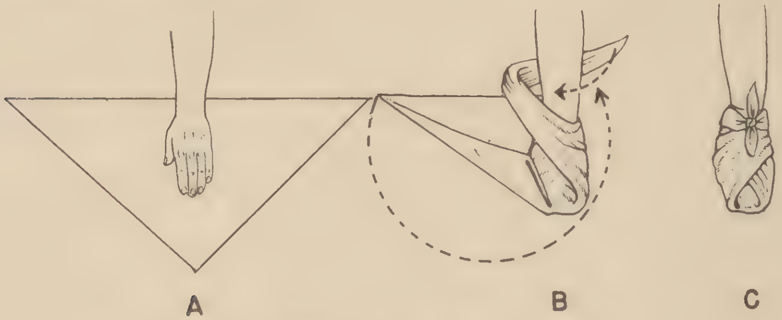


Figure 79. Triangle bandage applied to the hand.

PROCEDURE

1. Place the hand or foot in the center of the bandage with the fingers or toes pointing toward the apex of the bandage.
2. Fold the apex of the bandage over the back of the hand or the instep of the foot, folding the slack bandage along side of the hand or foot.
3. Bring the free ends of the bandage around the wrist or ankle crossing them front and back and secure by tying.

BANDAGING; TRIANGLE BANDAGE OF SCALP OR FOREHEAD, APPLICATION OF

PURPOSE

To provide an emergency covering for injuries of the head.

MATERIALS

1. Triangle bandage.
2. Safety pin.

PROCEDURE

1. Place the middle of the base of the triangle over the center of the forehead just above the eyebrows.
2. Carry apex of the triangle over the top of the head and down to the back of the neck.

3. Carry the ends of the base of the triangle backwards, cross them over the apex of the bandage at the back of the head, and bring them around to the front and tie.

4. Fold loose ends of apex of bandage over and under the loop formed by the tied bandage ends at the back of the head. Secure with safety pin.

PRECAUTION

Be sure that triangle bandage is of sufficient size to adequately cover head.

BANDAGING; TRIANGLE BANDAGE, SLING, APPLICATION OF

PURPOSE

To support and partially immobilize an injured upper extremity.

MATERIALS

1. Triangle bandage.
2. Safety pin.

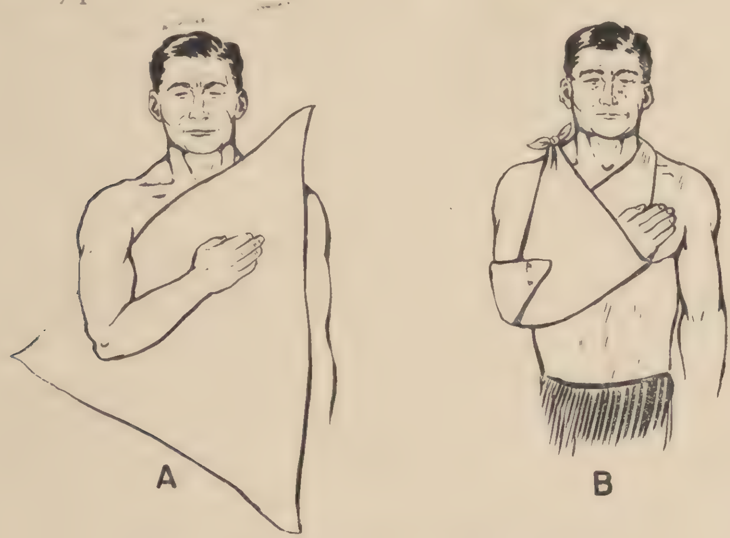


Figure 80. Triangle bandage applied as a sling.

PROCEDURE

1. Place the bandage so that its apex extends under the arm of the injured extremity and the upper end of its base extends over the shoulder on the uninjured side.

2. Place the forearm and hand of the injured extremity against the bandage and bring the lower end of the base of the bandage over the injured extremity and tie it to the upper end of the base behind the patient's neck.

3. Tie a knot in the apex to take up slack at the elbow. This end may also be carried around the elbow and pinned.

PRECAUTION

The sling should be applied in such a way as to hold the injured extremity in proper position. Unless contraindicated the hand of the injured extremity should be near the opposite shoulder.

BANDAGING; VELPEAU, APPLICATION OF

PURPOSE

To immobilize and support the arm or shoulder joint in the presence of a suspected fracture or dislocation.

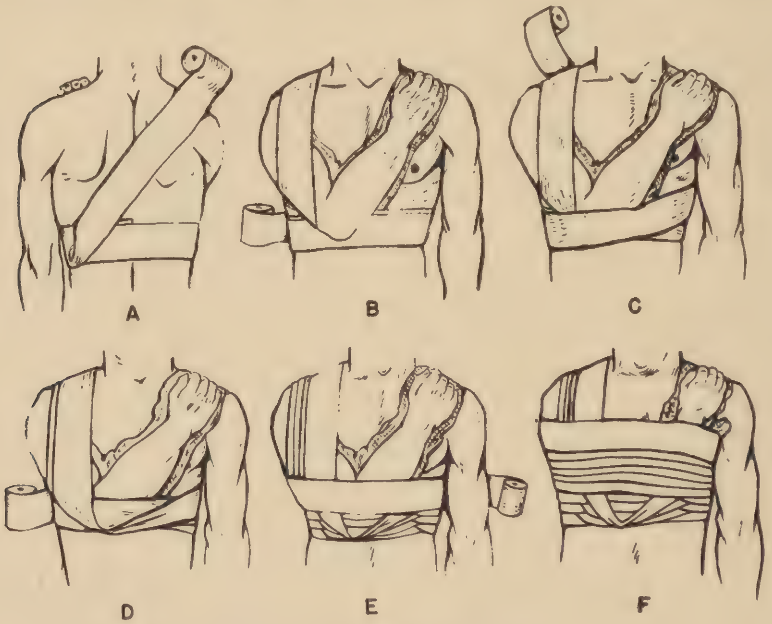


Figure 81. The Velpeau bandage.

MATERIALS

1. Four 3-inch rolls of gauze, flannel, muslin, or elastic roller bandage.
2. Gauze or gauze-covered cotton.
3. Roll of adhesive tape, 2 inches wide.

PROCEDURE

1. Place injured extremity across chest with fingers curved over opposite shoulder.

2. Separate all touching skin surfaces with padding and adequately pad both armpits.

3. Anchor bandage around the trunk by two circular turns placed below the point of the elbow of the injured extremity.

4. Near the completion of the second circular anchoring turn, reverse bandage, and carry it over shoulder blade and shoulder of the affected side.

5. Carry bandage over the outer surface of the arm of the affected side and between the flexed elbow and the body.

6. Then carry bandage around the body once more, then over the arm slightly above the level of the joint of the elbow.

7. Carry the bandage over the shoulder again, overlapping the previous turn in the process.

8. Carry the bandage around and over the flexed elbow.

9. Encircle the body again, one or two inches higher than the previous turn and return the bandage to the affected shoulder.

10. Repeat procedure until affected extremity is satisfactorily supported and immobilized.

PRECAUTIONS

1. Maintain even, smooth tension throughout the application of the bandage.

2. Periodically check the color of the hand of the bandaged extremity and the radial pulse. If pulse is absent or weak and if hand becomes cold and cyanosed, removed bandage and reapply less firmly with less padding in axilla.

3. Since the bandage is to remain in place for some time, adequate protection of all touching skin surfaces is necessary.

4. Be sure that the arm remains in correct position with fingers curved over opposite shoulder, throughout the procedure.

BATH; CLEANSING

PURPOSE

1. To maintain personal hygiene.
2. To prevent skin irritations.
3. To stimulate peripheral circulation.
4. To encourage rest.

MATERIALS

1. Bath basin half full of warm water.
2. Wash cloth.
3. Bath towel.
4. Face towel.
5. Soap.
6. Bath blanket.
7. Linen for changing bed.
8. Rubbing alcohol.
9. Kidney basin.
10. Mouthwash cup.
11. Toilet articles (toothbrush, comb, etc.).

PROCEDURE

1. Place clean linen on chair at bedside.
2. Loosen upper bed clothing.
3. Place bath blanket over patient and remove all covers.
4. Mouth care (see separate procedure).
5. Wash and dry each part of patient's body. Protect bed with towels. Bathe patient in following sequence:
   - (a) Face, neck, and ears.
   - (b) Arms and hands.
   - (c) Chest and axilla.
   - (d) Abdomen.
   - (e) Legs and feet.
   - (f) Back.
   - (g) Genitalia.
6. Rub back with alcohol.
7. Make bed with clean linen (see special procedure).

PRECAUTIONS

1. Never expose patient. Use bath blanket at all times.
2. Avoid chilling patient.
3. Assist the patient in moving and turning in order to prevent unnecessary exertion.

BATH; SPONGE, TEPID

PURPOSE

To reduce fever.

MATERIALS

1. Basin containing cool water, temperature 75° to 85°F. (24° to 29°C.).
2. Wash cloths.
3. Bath towel.
4. Bath blanket.
5. Ice cap.
6. Hot water bottle.
7. Rubber sheet.
8. Cotton draw sheet,
9. Thermometer tray.
10. Rubbing alcohol.

PROCEDURE

1. Wash hands and assemble equipment at bedside.
2. Explain treatment to patient.
3. Protect bed with rubber sheet and cotton draw sheet.
4. Remove sleeping garments and replace top bedding with the bath blanket.
5. Apply hot water bag to feet and ice cap to head.
6. Wring out wash cloths in cool water and place one in each axilla, one on each inguinal region, and one under each popliteal region. Replace wash cloths frequently.
7. Alternately sponge face, each extremity, and back. Five minutes should be spent sponging cool water on each area. While this is being

done, the remainder of the body should be covered with the bath blanket.

8. Give patient cold water to drink during treatment.

9. Watch patient carefully during treatment. Check pulse and respirations at frequent intervals.

10. Complete treatment with alcohol back rub.

11. Remove protective sheets, blanket, ice cap, and hot water bottle, and rearrange the bed.

12. Clean and store equipment.

13. Obtain and record temperature, pulse, and respirations one half hour after completion of treatment.

14. Record treatment and reaction on patient's chart.

Hour	Date	Wt.	Urine	Stool	Medication	Diet	Remarks
1000	7/20/45						Restless and somewhat irrational. T.P.R. 104.8°-130-32.
1015					Tepid sponge bath		No unfavorable reaction. Pulse good, respirations regular.
1045							T.P.R. 102°-100-26. Resting comfortably. Dozing at intervals.

PRECAUTIONS

Discontinue treatment and apply external heat if the patient develops a rapid, weak or irregular pulse, chill, cyanosis, or rapid, shallow respirations.

BATH; STARCH OR OATMEAL

DEFINITION

This is the application to the body of emollient or soothing substances obtained from starch or oatmeal suspended in water.

PURPOSE

To relieve skin irritation.

MATERIALS

1. Cornstarch suspension.

Add cold water in small quantities to one pound of cornstarch and stir to a smooth paste. Hot water is then slowly added. Stir constantly. When mixture is thin enough to pour, add to and mix thoroughly with the bath water.

One pound of starch suspension is sufficient to prepare 30 gallons of bath water (2/3 of a tub).

2. Oatmeal suspension.

Wrap 3 cups of cooked oatmeal in a porous cloth. Stir bag around in bath water until water becomes milky.

PROCEDURE

1. If possible, immerse patient in tub of water containing one of the above suspensions.
2. Have patient remain in tub for ten to twenty minutes. Bath water should be slightly cool.
3. If immersion of patient is impossible, apply the bath by sponging.
4. Allow bath water to dry on patient's skin.
5. Repeat procedure as often as necessary.

PRECAUTIONS

1. Do not chill patient.
2. Do not rub skin with a towel.

BED PATIENT; DYING AND DEAD, CARE OF

PURPOSE

1. To insure mental and physical comfort of the dying patient.
2. Proper disposal of body and effects after death.

SIGNS OF APPROACHING DEATH

1. Generalized loss of muscle tone:
   Incontinence of urine and feces.
   Drooping eyelids.
   Death rattle due to inability to swallow mucus in throat.
2. Slowing of circulation:
   Feet, hands, ears, and nose cold to touch.
   Extreme pallor of body.
   Cyanosis of lobes of ears, lips, and fingernails.
   Skin mottled due to congestion of blood in veins.
3. Film over cornea of eye.
4. Variance of temperature: either below normal or extremely high.
5. Instability of pulse: very rapid or slow and gradually becoming imperceptible.
6. Change in respirations:
   Rapid and shallow.
   Irregular.
   Slow and labored.

CARE OF DYING PATIENT

1. Relieve mental and emotional stress:
   Call chaplain if possible.
   Take care of any legal affairs.
2. Relieve physical discomfort:
   Relieve severe pain by the administration of morphine sulphate in ¼ grain doses.
   Keep mouth and lips clean and moist.
   Support patient with pillows and change position in bed frequently.
   Change bed linen frequently, if patient is incontinent.
   Maintain intake of fluids, nourishment, and medicines as long as possible. Do not feed or give fluids by mouth to an unconscious patient.

PROOF OF DEATH

No heart beat or respiration for twenty minutes. A simple test for respiration is to hold a mirror in front of the nose or mouth and if moisture does not collect, respiration is absent.

THE CARE OF THE DEAD

1. The fact that the patient has died must be certified by the master of the ship. The time, place, and apparent cause of death must be entered in the medical log or patient's chart by the Hospital Corpsman.

2. If possible, preserve the body by refrigeration until arrival at the next port. The body should be cleaned, draining wounds and ulcers covered with clean dressings, and the openings to all body cavities packed with cotton. Attach identification tag to body giving man's name, serial number if any, and date and hour of death. Wrap body in clean sheet and place in appropriate size box or container.

3. If impossible to keep body in a proper manner with safety to the ship, body should be buried at sea.

DISPOSITION OF EFFECTS

The personal effects of the deceased should be carefully inventoried and listed in the presence of witnesses. These effects should then be wrapped and delivered to the master of the ship for safekeeping.

BED PATIENT; EVENING CARE OF

DEFINITION

Evening care is the attention given to a bed patient at bedtime.

PURPOSE

1. To make the patient comfortable for the night.
2. To induce sleep.

MATERIALS

1. Basin of warm water.
2. Soap.
3. Wash cloth.
4. Face towel.
5. Material for mouth care.
6. Bed pan.
7. Urinal.
8. Toilet paper.
9. Clean linen as indicated.
10. Sterile dressings if needed.
11. Thermometer tray.
12. Rubbing alcohol.
13. Extra blanket for warmth.

PROCEDURE

1. Wash patient's hands and face.
2. Give mouth care.
3. Comb hair.
4. Offer bed pan or urinal as needed.
5. Rub back with alcohol.
6. If patient has draining wounds or is incontinent, change soiled linen.
7. Change soiled dressings.
8. Obtain and record temperature, pulse, and respirations.
9. Provide fresh drinking water.
10. Give necessary medications.
11. Place extra blankets on the bed if needed.
12. Ventilate room.

PRECAUTIONS

If patient is not being supervised during the night, provide a signal, such as a hand bell, so that he can summon aid.

BED PATIENT; IRRATIONAL, CARE OF

PROCEDURE

Give routine care for bed patient.

PRECAUTIONS

1. Prevent the patient from injuring himself or others by applying the proper restraints. Obtain permission from ship's master.

2. If patient refuses to swallow, give water, nourishing liquids, and medications by nasal gavage. It may be necessary to apply mummy restraint during the procedure.

3. Check urinary output carefully. Patient may have retention of urine or be incontinent.

4. Take temperature by rectum.

5. Keep the patient warm.

6. Keep irrational patients under constant observation and supervision.

7. Remove all articles, with which the patient may injure himself or others, from room.

BED PATIENT; MORNING CARE OF

DEFINITION

Morning care is the attention given to a bed patient to prepare him for breakfast.

PURPOSE

To make the patient comfortable upon awakening.

MATERIALS

1. Basin of warm water.
2. Soap.
3. Wash cloth.
4. Face towel.
5. Material for mouth care.
6. Bed pan.
7. Urinal.
8. Toilet paper.
9. Clean linen as indicated.
10. Sterile dressings if needed.
11. Thermometer tray.

PROCEDURE

1. Remove extra covers provided for warmth during night.
2. Wash patient's hands and face.

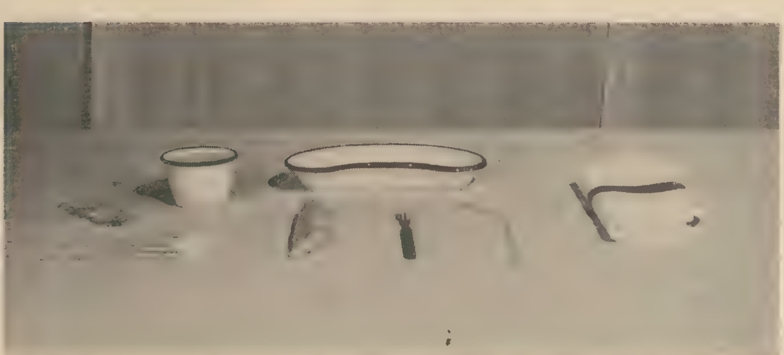
3. Give mouth care.
4. Comb hair.
5. Offer bed pan or urinal as needed.
6. If patient has draining wounds or is incontinent, change soiled linen.
7. Change soiled dressings.
8. Provide fresh drinking water.
9. Obtain and record temperature, pulse, and respirations.
10. Give necessary medications.
11. Serve breakfast.

BED PATIENT; MOUTH CARE OF

PURPOSE

To maintain good oral hygiene for the very ill or helpless patient.

MATERIALS



1. Toothbrush and dentrifice.
2. Cup containing mouth wash: normal saline, alkaline mouth wash, hydrogen peroxide 1 part to 3 parts water.
3. Emesis basin.
4. Face towel.
5. Drinking tube.
6. Equal parts lemon juice and glycerine or mineral oil.

PROCEDURE

1. Place towel and emesis basin under patient's chin to protect bedding.
2. Moisten tooth brush with dentrifice and brush outer surfaces of upper and lower teeth, toward the biting edge. Brush the inner surfaces the same way.

3. Allow patient to rinse mouth using glass drinking tube. If patient is too weak to use drinking tube, turn his head to one side and irrigate the mouth using an asepto syringe.

4. Swab dry, crusted gums, tongue, and lips with equal parts of lemon juice and glycerine or mineral oil.

5. Remove equipment, wash, sterilize by boiling, and store.

PRECAUTIONS

1. If gums are tender or bleeding, cotton-tipped applicators may be substituted for a tooth brush.

2. Use a tongue depressor to hold the patient's mouth open if necessary.

BED PATIENT; POST OPERATIVE, CARE OF

PROCEDURE

Give routine care for bed patient.

PRECAUTIONS

1. Place the patient in a bed which has been prewarmed with hot water bottles and is protected with a rubber sheet. Position of the patient will be ordered by the physician: Trendelenberg, Fowler's, or dorsal recumbent.

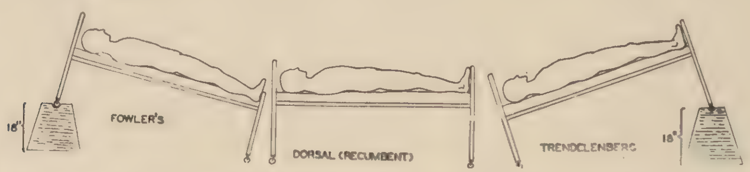


Figure 82. Diagram showing certain therapeutic positions.

2. Have basin and paper wipes at bedside to take care of mucus and vomitus. If vomiting occurs, keep patient's head turned to one side to prevent inhalation of stomach contents.

3. Stay with the patient until he has completely recovered from the anesthetic. Check pulse and respirations every fifteen minutes.

4. Inspect surface of dressings frequently for hemorrhage.

5. Turn the patient every two hours to guard against congestion in the lungs. Encourage deep breathing.

6. Keep patient warm and dry. Profuse sweating may occur, necessitating frequent changing of the bed linen.

7. Check urinary output. It may be necessary to catheterize the patient.

8. Obtain and record temperature, pulse, and respirations every four hours.

9. Stay with the patient the first time he is allowed out of bed. He may become faint.

10. Carry out physician's orders regarding diet, enemas, change of dressings, and other special treatments. Use sterile technique when changing dressings to prevent infection.

BED PATIENT; ROUTINE CARE OF

PURPOSE

1. To keep the patient comfortable.
2. To prevent complications.
3. To hasten recovery.

PROCEDURE

0700—Give morning care.

0800—Serve breakfast.

0900—Administer after-breakfast medications.

1000—Give complete bed bath, mouth care, and alcohol rub. Change bed linen and follow by mid-morning nourishment, such as a glass of fruit juice or milk.

1130—Obtain and record temperature, pulse, and respirations and administer necessary medications.

1200—Serve lunch.

1300—Administer necessary medications, and if the patient's condition warrants it, exclude visitors from the sick bay and insist that he rest or sleep for one hour.

1430—Serve mid-afternoon nourishment.

1630—Obtain and record temperature, pulse, and respirations and administer necessary medications.

1700—Serve supper.

1800—Administer necessary medications.

2100—Give evening care.

PRECAUTIONS

1. Give all medications and treatments as indicated and on time. Record on patient's chart.

2. Change hours of administering medications if necessary to fit in with the ship's schedule.

3. Observe the patient carefully for change in condition and alter treatment accordingly.

4. Turn the patient, if he is unable to turn himself, at least every two hours during the day. Encourage deep breathing to prevent congestion of the lungs.

5. If patient has high fever, force fluids and reduce temperature with tepid sponge baths.

6. If patient is acutely ill, spare him unnecessary exertion to conserve his energy.

7. Give diet as indicated by patient's condition.

8. Protect eyes with dark glasses if patient complains of photophobia.

9. Give additional mouth care if required.

10. Relieve itching skin rashes with starch bath or calamine lotion.

11. Give enemas or cathartics as needed.

12. If patient has a contagious disease, isolate and carry out concurrent disinfection. When he is discharged from the sick bay, carry out terminal disinfection.

BED PATIENT; UNCONSCIOUS, CARE OF

PROCEDURE

Give routine care for bed patient.

PRECAUTIONS

1. Try to determine the cause of the unconsciousness.

2. If convulsions accompany unconsciousness, put a wedge between teeth to prevent the patient from biting his tongue.

3. Give mouth care at least four times daily.

4. Check urinary output carefully. Patient may be incontinent or have retention of urine.

5. Give water, medication, and nourishing liquids by gavage.

6. Restrain the patient if necessary to prevent him from falling out of bed.

7. Turn the patient at least every two hours to prevent decubitus ulcers and hypostatic pneumonia.

8. If patient vomits, keep his head turned to one side to prevent aspiration of stomach contents into the lungs.

9. Take temperature by rectum.

10. Keep the patient warm.

BUNK; OCCUPIED, MAKING OF

PURPOSE

To change linen on the occupied bunk with the least amount of discomfort to the sick patient.

PROCEDURE

1. Obtain necessary bed linen: three sheets, one bed spread, and one pillow case. Place on chair beside the bunk.

2. Remove soiled bedspread and top sheet, without exposing the patient. Keep patient covered with a blanket. Remove pillow if patient is comfortable without it.

3. Turn patient toward you. Be sure his shoulders and hips are well back from the edge of the bunk so he will not fall out.

4. "Fan fold" soiled cotton draw sheet to center of bunk, well under patient's back. "Fan fold" rubber sheet and bottom sheet in the same manner. This will leave one half of mattress without linen.

5. Fold clean sheet lengthwise and place on mattress with fold in center, narrow hem at the bottom. Allow 12 inches to tuck under top of mattress.

6. "Fan fold" upper layer of sheet close to patient's back. Tuck in the free edge of lower surface all along the side of the bunk. Leave the top and bottom of the sheet free.

7. Draw free end of rubber sheet back to side of bunk and tuck under mattress.

8. Fold a draw sheet hem to hem and place on bunk with the fold in the center, close to the patient.

9. "Fan fold" the upper layer of the sheet in close to the patient. Tuck in the under surface at side of bunk. If regular draw sheets are not available, fold a full size bunk sheet to the desired size.

10. Turn patient toward the bulkhead.

11. Remove soiled draw sheet, "fan fold" rubber sheet up close to patient's back, and remove soiled bottom sheet.

12. Pull clean bottom sheet through and tuck in all along the side. Make envelope corners at the head and foot of bunk. Make sure there are no wrinkles in the sheet.

13. Draw free ends of rubber sheet and clean cotton draw sheet over to side of bunk and tuck under mattress.

14. Turn patient on his back.

15. Place clean top sheet over patient with wide hem at top. Pull sheet up high enough to reach top of mattress.

16. Remove blanket from beneath top sheet without exposing the

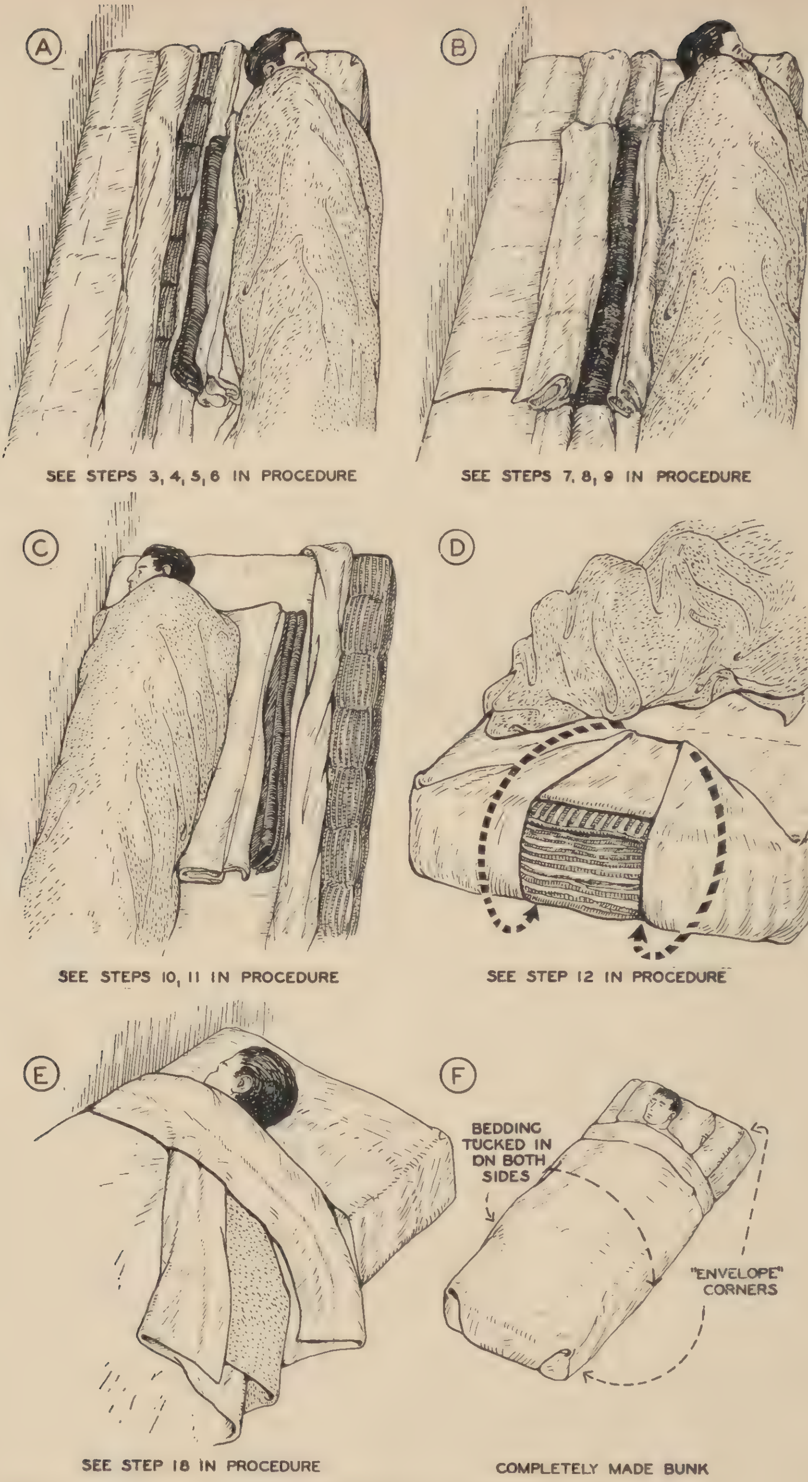


Figure 83. Making an occupied bunk.

patient and tuck sheet under mattress on each side. Leave the bottom of the sheet free.

17. Place blanket over top sheet. Pull it up far enough to cover the patient's shoulders. Tuck under mattress on both sides. Leave the bottom of the blanket free.

18. Place spread over blanket. Pull it up far enough to tuck about four inches of it over the upper edge of the blanket. Fold the top sheet down over the blanket and spread. Tuck spread under mattress on both sides.

19. Make envelope corners of the sheet, blanket, and spread at bottom of bunk.

20. Replace soiled pillow slip with a clean one and place pillow under patient's head.

21. Remove soiled linen and leave room tidy.

PRECAUTIONS

1. Do not expose patient at any time.
2. Help the patient to turn. Spare him unnecessary exertion.
3. If supply of linen is adequate, make complete change of linen once daily. Incontinent patients or patients who perspire profusely need more frequent changes.
4. Avoid pulling covers too tight over feet.

BUNK; SHOCK OR ANESTHETIC, MAKING OF

PURPOSE

1. To provide extra warmth following injury or surgery and thus help to prevent shock.
2. To place the patient in bed in the proper position to prevent or treat shock.

MATERIALS

1. Two sheets.
2. Two blankets.
3. Roll of 2-inch bandage.
4. Two hot water bottles.
5. Two rubber sheets.

PROCEDURE

1. Assemble equipment and place on a chair beside a clean, empty bunk.
2. Remove top sheet, blanket, and spread from bunk.
3. Place one rubber draw sheet across middle of bunk and tuck under mattress on both sides.

4. Fold a sheet hem to hem and place on top of rubber sheet with fold toward top of bunk. Tuck under mattress on both sides.

5. Place one of the extra blankets on the bunk. Pull it up so the top edge is even with the top of the mattress. Tuck under mattress on both sides. Make envelope corners at foot of bunk and tuck blanket under mattress.

6. Place the other rubber sheet at head of bunk. Tuck under mattress on both sides.

7. Fold sheet hem to hem and place over rubber sheet with hems at top. Tuck under mattress on both sides. Make envelope corners at top and tuck under mattress.

8. Place the other extra blanket on the bunk, top edge even with edge of mattress. Tuck under mattress along bulkhead side.

9. Replace top sheet, blanket, and spread. Tuck under mattress along bulkhead side. Finish top fold as in the occupied bunk.

10. Fold top bedding and blanket up from foot of bunk and back from side so that the folded bed clothes are even with edge of mattress.

11. Secure pillow to the head of bunk with bandage.

12. Fill hot water bottles and place between the two blankets where the patient's shoulders and hips will rest.

13. Elevate foot of bunk or the lower end of the mattress 18 inches.

14. Before placing patient in bunk, remove hot water bottles and fold top covers back to bulkhead.

15. Place patient in bunk and pull covers over him. Tuck bed covers under mattress along side. Make envelope corners at bottom and tuck bed covers under mattress.

PRECAUTIONS

1. Make sure the hot water bottles have been removed before the patient is placed in the bunk.

2. In warm weather the extra top blanket may be eliminated.

BLOOD PRESSURE

DEFINITION

Blood pressure is the force of the blood exerted against the walls of the vessels in which it is contained.

Systolic blood pressure is the highest pressure produced by the forceful propulsion of the blood through the arteries at each contraction of the left ventricle.

Diastolic blood pressure is the amount of blood pressure maintained in the arteries during the period of cardiac relaxation.

PURPOSE

1. To aid in diagnosis.
2. To ascertain effect of certain drugs.

MATERIALS

1. Sphygmomanometer.
2. Stethoscope.

PROCEDURE

1. Explain procedure to patient.
2. Place patient in comfortable sitting or recumbent position with arm supported.
3. Wrap cuff of spyhgmomanometer around arm above elbow.
4. Place stethoscope in ears ready for use (ear pieces point forward).
5. Palpate pulsations of brachial artery near bend of elbow. Place bell of stethoscope over this point.
6. Inflate cuff with rubber bulb until no sound can be heard through stethoscope.
7. Release air pressure slowly with screw valve of bulb, while listening for sounds.
8. Note reading on manometer when first sounds are heard. Record as the systolic pressure.
9. Continue to release air pressure until there is an abrupt change in the sound. This is recorded as the diastolic pressure.
10. Always check readings for accuracy.

NOTE

1. The normal systolic blood pressure varies from 110 to 135 millimeters of mercury.
2. The normal diastolic blood pressure varies from 60 to 90 millimeters of mercury.
3. The difference between the two pressures is the pulse pressure. It is normally about one half of the diastolic pressure.
4. Blood pressure is always recorded systolic over diastolic: example, 120/80.

CATHETERIZATION OF THE URINARY LBADDER

PURPOSE

To empty the bladder of urine.

MATERIALS

1. Tray: plastic, enamel, metal.
2. Sterile towel.
3. Two sterile medicine glasses, one containing solution of boric acid 4%; the other containing green soap solution.
4. Six sterile 4 x 4 gauze compresses.
5. Sterile lubricant.
6. Sterile hemostat.
7. Three sterile rubber catheters, sizes 12F, 16F, 18F.
8. Sterile enamel or metal bowl containing 25 cc. of a 10% aqueous solution of argyrol or a 4% boric acid solution.
9. Sterile plungerless syringe.
10. Waste basin.
11. Urinal or bedpan.
12. 500 cc. graduate.
13. Bath blanket.

PROCEDURE

1. Assemble all sterile articles on sterile tray and bring all equipment, sterile or otherwise, to patient's bedside.
2. Explain the procedure to the patient to gain his confidence and cooperation.
3. Fold bedclothing down to patient's knees and cover upper body with bath blanket, leaving genital area exposed.

4. Place receptacle for urine, bedpan or urinal, between patient's legs.

5. **Wash hands.**

6. Cleanse penis by application of green soap solution with sterile compress held by hemostat. Rinse off green soap solution with sterile compress wet with boric acid solution. Place washed penis on sterile towel.

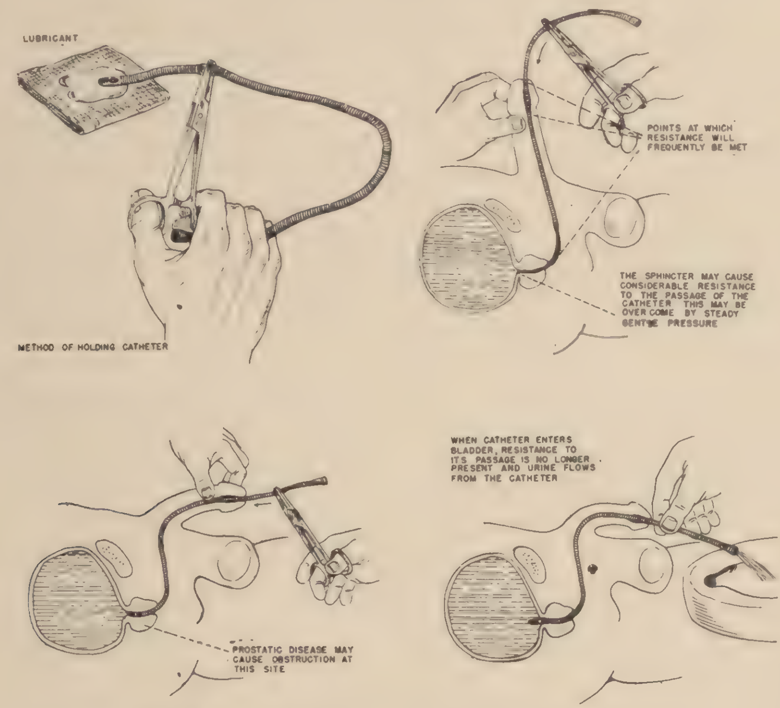


Figure 84. Catheterization of the urinary bladder.

7. Perform anterior irrigation of the urethra: Pinch off the urethra by compressing the penis along its ventral surface near pubic area of body proper. Insert tip of the plungerless syringe containing 4 cc. of argyrol or boric acid solution into the urethral opening. Slowly inject the solution and allow it to drain into receptacle between the patient's legs. Repeat irrigation three times to insure thorough cleansing.

8. Pick up catheter with hemostat and lubricate tip well. The hemostat should hold the catheter three inches from the tip. The opposite end of the catheter should be held between the ring finger and the little finger of the hand employing the hemostat.

9. Insert catheter slowly and gently until urine begins to flow.

10. Remove catheter when urine ceases to flow. While catheter is being removed, insert tip of plungerless syringe into end of catheter and inject 4 cc. argyrol solution so that the urethra is irrigated throughout its length.

11. Leave the patient dry and comfortable. Clean, sterilize and store equipment.

12. Record procedure on patient's chart.

PRECAUTIONS

1. This is a sterile procedure. Maintain proper technique throughout.

2. The catheter should be inserted along the urethra gently and evenly and should not be inserted forcibly or for an unreasonable distance, since this may injure the urethra or bladder.

CATHETERIZATION; INDWELLNG CATHETER, APPLICATION OF

PURPOSE

To eliminate the necessity for repeated catheterization and to insure steady continuous drainage from the bladder.

MATERIALS

1. All necessary materials for catheterization.
2. Two adhesive tape "butterfly" strips.
3. Two strips of adhesive tape, 4 inches long by 1 inch wide.
4. Extra hemostat or tubing clamp.
5. Receptacle for urine.
6. Rubber tubing with glass connecting tip.

PROCEDURE

1. Perform catheterization and leave catheter in place.

2. Apply the two "butterfly" adhesive tape strips to the penis and catheter. One "butterfly" strip is applied on the dorsal surface of the penis and carried over to the catheter; the other "butterfly" strip is applied along the ventral surface of the penis and carried over to the catheter.

3. Apply the two 4" x 1" straight adhesive strips. One strip is wrapped around the penile attachment of the "butterfly" adhesive tape strips, while the other is wrapped around the catheter attachment of the "butterfly" adhesive tape strips close to the urethral opening.

4. Attach the rubber tubing to the catheter by means of the glass connecting tip.

5. Attach the hemostat or the tubing clamp to the rubber tubing to control urine drainage.

6. Clean, sterilize, and store all used materials.

7. Record procedure on patient's chart.

PRECAUTIONS

1. When applying the "butterfly" adhesive strips, do not let the adhesive surface adhere to the sensitive surface of the glans penis.

2. Do not apply the adhesive tape too tightly around the shaft of the penis.

3. An indwelling catheter should never be left in place for more than three days. At the end of this time replace the used catheter.

CHARTING

PURPOSE

1. To provide a clear, concise record of the patient's condition and progress.

2. To record the medications and treatments the patient receives and the effects obtained.

3. To provide information regarding circumstances surrounding accidents which may lead to investigation concerning hazards at sea.

4. To provide an authentic record which might be used in a court proceeding.

PROCEDURE

1. Print in ink or type all notations on the chart.

2. Make statements brief but correct in every detail.

3. Include in the admission note: the circumstances surrounding any illness or accident; the subjective and objective symptoms which were present at the time of admission; the temperature, pulse, and respirations on admission; and the "impression" (tentative diagnosis).

4. Record each observation in a separate paragraph.

5. Record all medications and treatments, the time they were given, and the reaction. Make this notation immediately after the medications and treatments have been given.

6. Record all dressings changed and any abnormalities noted.

7. Record all symptoms and note any change in the patient's condition. Record the apparent mental condition of the patient.

8. Record temperature, pulse, and respirations each time they are obtained. Note anything unusual about the quality of pulse or respirations.

9. Record amount of urine voided in cc. or ounces in the column marked "Urine". In the "Remarks" column note anything unusual about the color, odor, or amount of urine.

10. Record in the "Diet" column the kind of diet given and the nourishment and water given between meals. Make some comment in the "Remarks" column as to whether or not the food was retained and what kind of appetite the patient has.

11. Record bowel movements with "√" in the column marked "Stool", whether it be natural, the result of a laxative, or the result of an enema. In the "Remarks" column note anything unusual about the color or consistency of the stool.

12. Record medications by placing the name of the medication first, then the measurement (grams, grains, drams, etc.), then the amount in Roman numerals; e.g. aspirin gr. V (not 5 gr. of aspirin).

13. Write a summary of the patient's general condition before transferring him to the care of a physician or discharging him from the sick bay.

14. Sign admission note and summary. Initial other notations.

PRECAUTIONS

1. Do not erase mistakes. Mark through an error and recopy, indicating that an error was made.

2. Use accurate spelling.

3. Do not use the word "Patient" anywhere on the chart. The entire chart pertains to the patient.

4. Do not permit the patient or other members of the crew to read the chart.

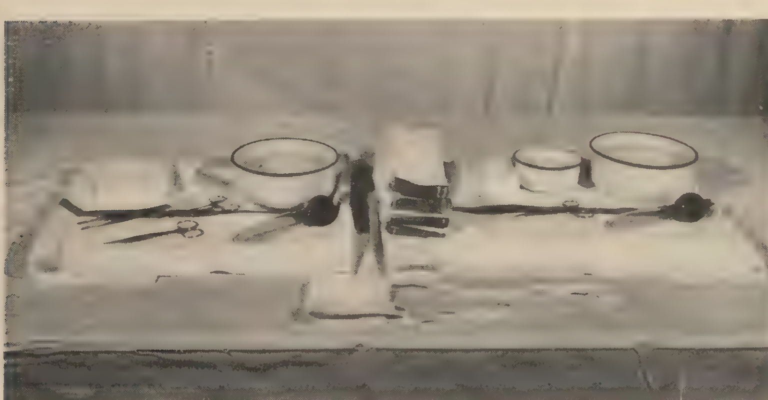
5. If no printed chart is available, one should be improvised.

CLEANSING AND IRRIGATING OPEN WOUNDS

PURPOSE

To minimize the opportunity for infection in open wounds.

MATERIALS



1. Warm, sterile, normal saline.
2. Warm, sterile water.
3. White soap flakes.
9. Two sterile plungerless syringes.
5. Two sterile hemostats.
6. Four sterile towels.
7. Sterile basin for soap solution.
8. Sterile thumb forceps.
9. Two sterile plungerless syringes.
10. Sterile tissue scissors.
11. Face mask.

PROCEDURE

1. Cover nose and mouth with face mask.
2. Wash hands thoroughly.
3. Assemble two sterile trays; one for washing the skin, the other for the treatment of the wound.
4. Prepare soap solution, making heavy suds.
5. Cover wound with sterile compress.
6. Pick up another sterile compress with hemostat, dip in soap solution, and thoroughly clean area around wound.
7. Rinse off soap with sterile water from plungerless syringe. Direct flow of water away from wound.
8. Repeat cleansing and rinsing five or six times.

9. Remove compress covering wound and put aside utensils used for skin cleaning. Drape the area with sterile towels.

10. Remove foreign bodies from wound with sterile thumb forceps and trim away all obviously loose and devitalized tissue tags from wound with sterile tissue scissors.

11. Irrigate wound with large quantities of sterile normal saline. Tilt the part so that the irrigating solution flows promptly from the wound.

12. Direct flow of normal saline so as to penetrate to and clean out the deep recesses of the wound.

13. Repeat normal saline wound irrigation five or six times. Use 2 or 3 quarts of sterile normal saline to irrigate a moderate sized wound of fairly deep penetration.

PRECAUTIONS

1. The hands should never touch the wound. *Instruments used for cleansing the skin should never be used for wound irrigation.*

2. A new sterile compress must be used each time soap is applied to the skin or each time a compress is applied to the wound for the control of bleeding or any other purpose.

3. Do not allow the syringes to touch the skin or the wound.

4. The removal of blood clots at the time of irrigation may produce bleeding which can be easily controlled by applying pressure to the bleeding point with sterile compresses held by sterile thumb forceps.

5. Shave hair from area immediately surrounding the wound during skin cleaning.

DIETS

The normal individual in health is ordinarily able to choose a wide enough variety of food to supply his nutritional needs by simply following the dictates of his appetite. Within certain limits, he is also able to indulge in mild dietary indiscretions without ill effects to his health. Likewise, his body is flexible enough to compensate for periods of deprivation by calling upon stored food. When these stores of food have been exhausted, the vital functions of the body are maintained by the conversion of body tissues into energy. Certain foods are stored to an extremely limited degree and unless they are supplied in a short period of time, definite ill effects are quickly noticeable. The most important of these substances are water, vitamins, and mineral salts.

In sickness, the gastro-intestinal tract is unable to compensate for dietary indiscretions, and in many instances, the consumption of certain foods that are easily tolerated in health leads to side actions which seri-

ously interfere with the patient's recovery. While the body still retains its ability to utilize stored foods and to convert its own tissue into energy, this is undesirable since it leads to a diminution of recuperative powers. For these reasons, a diet in sickness must contain an adequate amount of water, vitamins, and mineral salts. An adequate amount of nourishment must be consumed to maintain body processes without calling too heavily upon stored reserves. This food must be of a nature that is easily digested and sufficiently appetizing to be consumed by the sick person.

The Hospital Corpsman's approach to the dietary problems of the sick is relatively simplified because his duty is to select a diet that will tide the patient over a short period of time until treatment can be transferred to a better trained individual. By following the broad principles outlined above, the Hospital Corpsman will be able to select a diet from those listed that will be adequate for the patient.

CLEAR LIQUID DIET

This diet is to be used for patients with very high fevers or severe gastro-intestinal disturbances, and as a preliminary diet to the resumption of more normal feeding post-operatively. The quantity and number of the liquids will depend upon the patient. Water by other routes of administration and nourishment in the form of intravenous glucose will probably be required.

1. Water
2. Strained meat broth
3. Rice or barley water
4. Black coffee
5. Tea without cream
6. Gelatin without added fruit.
7. Strained fruit or vegetable juices

FULL LIQUID DIET

In addition to the liquids listed above:

1. Strained and creamed soups
2. Gruel
3. Milk and milk drinks
4. Ice cream

SOFT DIET

In addition to the liquids listed above:

1. Well cooked cereals
2. White bread and crackers
3. Poached or soft boiled eggs
4. Cottage cheese
5. Cream cheese
6. Broiled or boiled fish
7. Pureed vegetables
8. Custards
9. Soft puddings
10. Stewed fruits

LIGHT DIET

In addition to the foods listed above:

1. Broiled steak
2. Veal and lamb chops
3. Liver
4. Roast beef
5. Lamb
6. All cooked and citrous fruits
7. Plain cake and cookies
8. Cooked vegetables

REGULAR DIET

Regular ship's mess.

DRESSING; BURN, APPLICATION OF

PURPOSE

To promote healing and prevent infection of burns.

MATERIALS

1. Sterile, petrolatum-impregnated gauze.
2. Sterile gauze compresses.
3. Sterile pressure dressing pads.
4. Two sterile hemostats.
5. Three inch gauze roller bandage or 3 inch elastic bandage.
6. Mask.

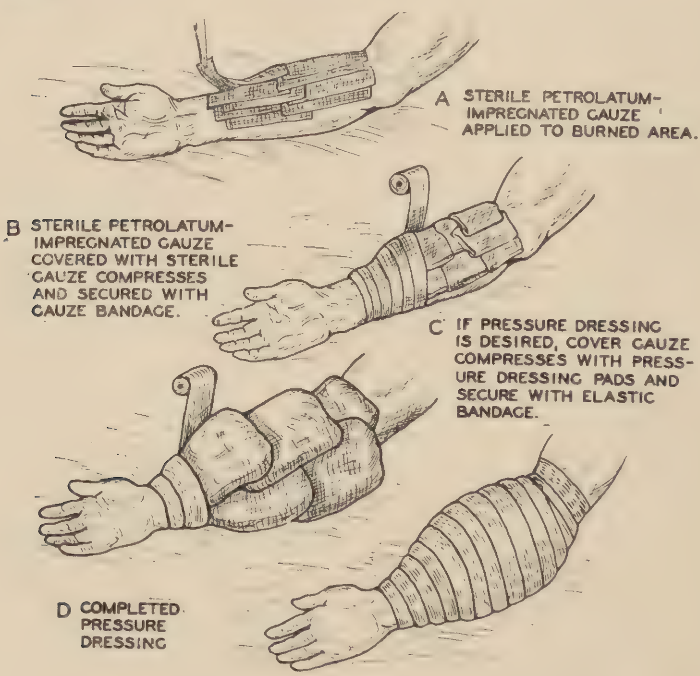


Figure 85. Pressure dressing applied to burn of forearm.

PROCEDURE

1. Cover nose and mouth with mask.
2. Wash hands thoroughly.
3. Apply sterile petrolatum-impregnated gauze to the burned area so that gauze extends 2 inches beyond burned area in all directions. The strips of sterile petrolatum-impregnated gauze should overlap by one half of their width.
4. Cover the sterile petrolatum-impregnated gauze with sterile gauze compresses and secure with gauze roller bandage.
5. If it is desired to apply a pressure dressing, apply several thicknesses (4 to 6) of sterile gauze compresses. Pressure dressing pads are then applied and tightly secured with elastic roller bandage. If sterile pressure dressing pads are unavailable, fluffed sterile gauze or nonsterile pads containing cotton may be substituted.

PRECAUTIONS

1. Change dressing as infrequently as possible. If possible, allow dressing to remain undisturbed for ten days. Frequent changes of dressings increase the risk of wound infection.
2. If edema develops beyond a pressure dressing, reapply the elastic bandage so that the edematous portion of the extremity is also bandaged. Apply the elastic bandage from the bottom up and elevate the extremity.
3. This is a sterile procedure. All sterile dressings are to be handled with a sterile hemostat whose only contact with the hands is at the handle.

DRESSING; COLLODION OR TINCTURE OF BENZOIN, APPLICATION OF

PURPOSE

To cover areas where a large dressing is unnecessary or inconvenient.

MATERIALS

1. Sterile absorbent cotton.
2. Collodion or tincture of benzoin.
3. Sterile applicator sticks.

PROCEDURE

1. Wash hands.
2. Tease the fibers of a small piece of sterile absorbent cotton apart until only a thin layer remains.
3. Place the thin layer of cotton over the wound and apply collodion or tincture of benzoin to the cotton and surrounding skin. The col-

lodion or tincture of benzoin is best applied with the applicator stick (without cotton tip) by rolling the collodion or tincture of benzoin-laden end over the cotton.

PRECAUTIONS

1. This dressing is applicable only to minor, relatively sterile, non-bleeding wounds.
2. Be sure all air bubbles are expressed when applying collodion or tincture of benzoin.
3. Be sure the edges of the cotton are flat and are sealed securely to the skin.

DRESSING; PRESSURE, FOR HEMORRHAGE CONTROL, APPLICATION OF

PURPOSE

To control hemorrhage and prevent infection in open wounds.

MATERIALS

1. Sterile pressure dressing pads.
2. Three inch elastic roller bandage.

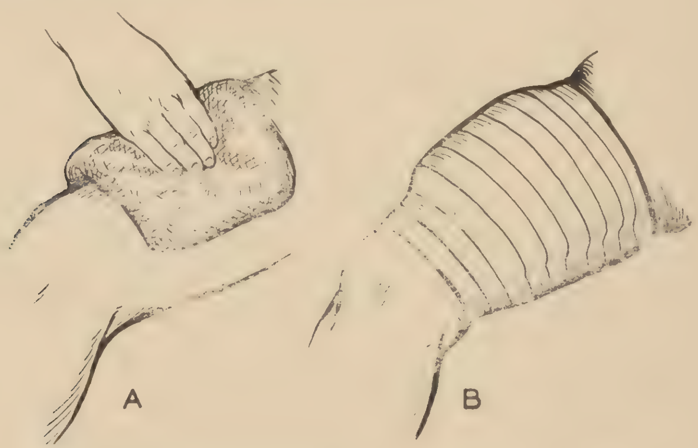


Figure 86. Pressure dressing applied to bleeding area of thigh.

PROCEDURE

1. Apply sterile pressure dressing pad over the site of hemorrhage and secure tightly with elastic roller bandage.
2. If pressure dressing pad is unavailable, apply fluffed sterile gauze compresses, and a large quantity of fluffed sterile cotton over the gauze

compresses. Secure this bulky, massive dressing tightly with elastic roller bandage.

3. Elevate bandaged part to prevent venous congestion.

PRECAUTIONS

1. Work fast to avoid excessive bleeding.

2. Avoid contaminating wound with hands.

3. Do not disturb the dressing, regardless of its appearance, for 12 hours. If blood continues to ooze through dressing beyond a short period of time, apply a second similar dressing more tightly over the first dressing.

4. Be sure the elastic bandage is not twisted or folded upon itself. Check distal point of extremity for evidence of inadequate blood supply.

DRESSINGS AND SUPPLIES; PREPARATION OF

PROCEDURE

4 x 4 Compresses

1. Cut gauze 8 inches by 16 inches.

2. Fold edges of gauze lengthwise to meet in the center and press firmly. Compress now measures 4 inches by 16 inches.

3. Fold ends to meet in center and press firmly. Compress now measures 4 inches by 8 inches.

4. Fold in half and press firmly. Compress now measures 4 x 4.

5. Sterilize by dry heat. Each package should contain six compresses.

2 x 2 Compresses

1. Cut gauze in 8-inch squares.

2. Fold edges of gauze lengthwise to meet in the center and press firmly. The compress now measures 4 inches by 8 inches.

3. Fold ends to meet in the center and press firmly. Compress now measures 4 inches by 4 inches.

4. Fold in half and press firmly. Compress now measures 2 inches by 4 inches.

5. Fold in half (top to bottom) and press firmly. Compress now measures 2 x 2.

6. Sterilize by dry heat. Each package should contain six compresses.

Eye Pads

1. Place a circular piece of absorbent cotton (full thickness of the roll) between two circular pieces of gauze. The diameter of the pad should be 2 inches.

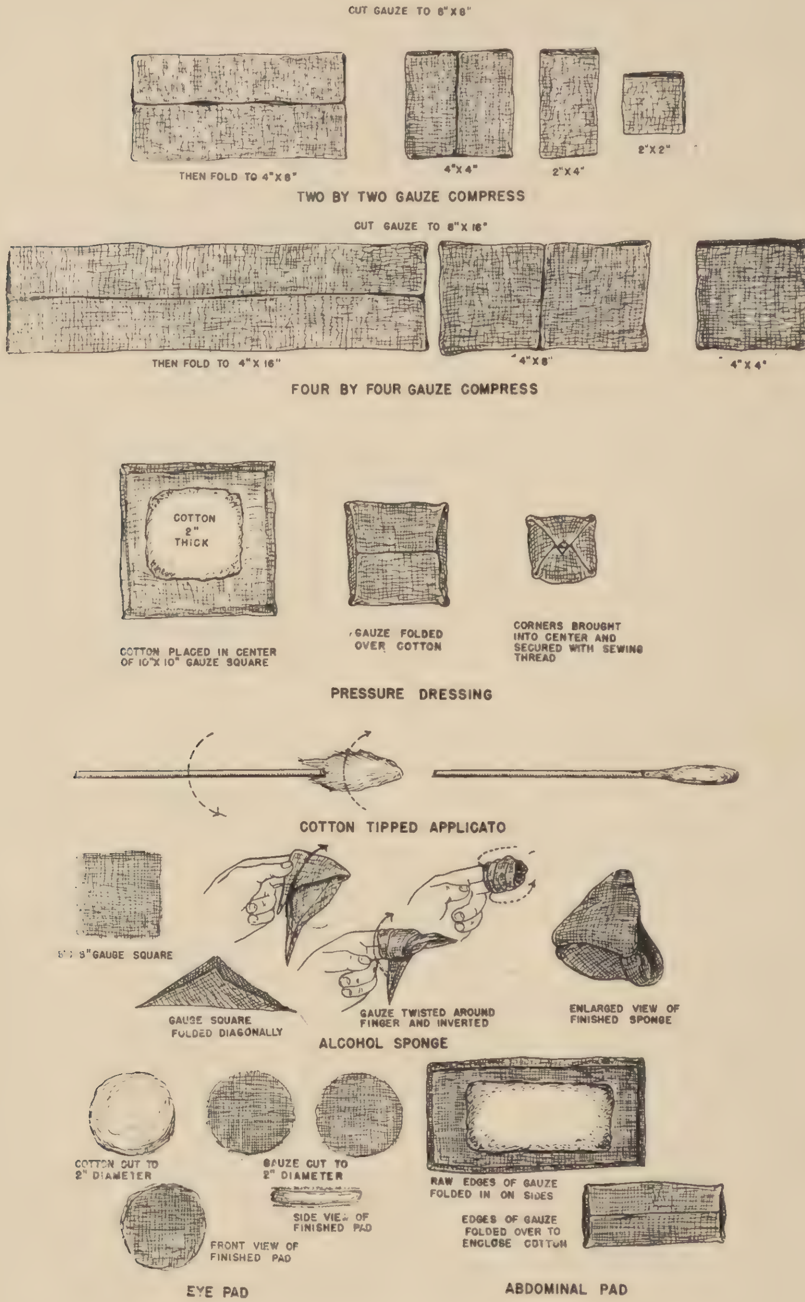


Figure 87. Preparation of dressings and related supplies.

2. Sterilize by dry heat. Each package should contain two eye pads separated and covered by circular pieces of cardboard the same size as the pads to preserve their shape.

Dressing Pads

1. Cut a piece of absorbent cotton (full thickness of the roll) 6 inches by 12 inches or in 12 inch squares, depending on the size of the wound and the amount of drainage.
2. Cut a piece of gauze twice as large as the piece of cotton.
3. Fold in ½ inch of the gauze on all sides to eliminate raw edges.
4. Place the cotton in the center of the gauze and fold the gauze over the cotton on all sides.
5. Sterilize individually by dry heat.

Pressure Dressing Pads

1. Make a pad 6 inches square and 2 inches thick using fluffed cotton. or other compressible material as a filler.
2. Fold back the four corners to meet in the center and secure by taking two or three stitches with sewing thread.
3. Sterilize individually with dry heat.

Wet Dressing; 4-Yard Leg Roll

1. Cut a piece of gauze 1 yard wide and 4 yards long.
2. Fold back ½ inch on each end of the gauze.
3. Fold lengthwise until all raw edges are turned in and the roll is 4 inches wide.
4. Roll as a bandage and secure the end with a pin.

Forceps Sponges

1. Cut gauze in 8 inch squares.
2. Fold one piece diagonally in half.
3. Grasp one end of the triangle between the thumb and index finger. Wrap the sponge loosely around the index and third fingers, making a cone.
4. Invert the cone and slip it off the fingers.
5. Sterilize by dry heat. There should be six forceps sponges in each package. These sponges may also be used as alcohol sponges.

Cotton Tipped Applicators

1. Slightly moisten one end of a wooden applicator or tooth pick.
2. Pick up a thin piece of cotton about the size of a five cent piece and twist the cotton around the moistened end of the stick by turning the stick in one direction and the cotton in the opposite direction.

3. Completely cover the tip of the applicator stick with cotton.
4. Sterilize by dry heat. Each package should contain six applicators.

PRECAUTIONS

1. Make sure all raw edges of gauze are turned in on any type of sponge or dressing. Loose threads in a wound may act as a foreign body.
2. Use only a single thickness of gauze to manufacture a dressing or pad.
3. Cover all cotton-filled dressings carefully with gauze to prevent cotton fibers adhering to a wound.

EAR; INSTILLATION OF EAR DROPS

PURPOSE

1. To relieve pain.
2. To relieve inflammation.

MATERIALS

1. Medication to be used.
2. Medicine dropper.
3. Absorbent cotton.

PROCEDURE

1. Wash hands.
2. Straighten ear canal by lifting external ear upward and backward.
3. Draw medication into dropper.
4. Hold tip of dropper at opening of ear canal and instill medication.
5. Instruct patient to remain in position for a few minutes.
6. Place small piece of cotton at entrance of auditory canal to absorb excess medication.

PRECAUTIONS

1. Oily preparations should be warm when administered.
2. Do not insert dropper into canal.

EAR CANAL; INSUFFLATION OF "SULFA POWDER"

PURPOSE

To check the growth of bacteria.

MATERIALS

1. Powder to be used.
2. Rubber bulb syringe or rubber bulb from atomizer.

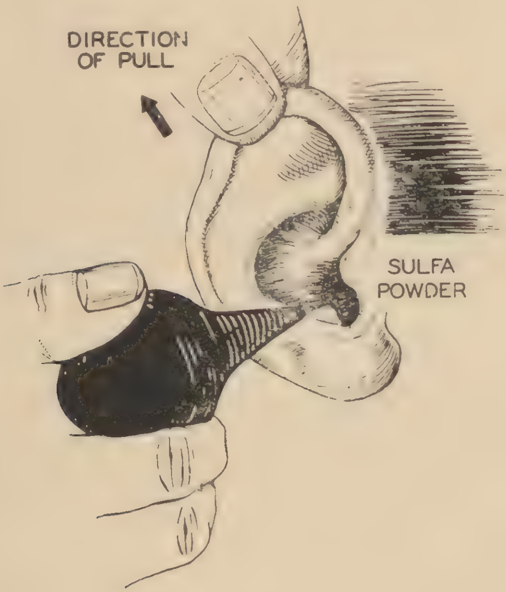


Figure 88. Insufflation of sulfa powder into ear canal.

PROCEDURE

1. Wash hands.
2. Straighten ear canal by lifting external ear upward and backward.
3. Dry ear canal with twisted pledget of cotton.
4. Place small amount of powder in opening of ear canal.
5. With rubber bulb syringe blow the powder into ear canal.

PRECAUTIONS

1. Use powder sparingly.
2. Do not insert bulb into the canal.

ENEMA; CLEANSING

DEFINITION

A cleansing enema is the injection of fluid into the rectum to provoke a bowel movement.

PURPOSE

1. To aid in defecation.
2. To relieve abdominal distention.
3. To stimulate peristalsis.

MATERIALS

1. Irrigating can with approximately 3 feet of rubber tubing with stopcock and glass connecting tip.
2. Rectal tube.
3. Lubricant.
4. Emesis basin.
5. Rubber sheet for the bed with a towel for covering.
6. Bedpan and toilet paper.
7. Warmed soap suds solution, 750 cc. (1½ pints). Use mild soap, and only enough to make a weak solution (slightly milky in appearance).

PROCEDURE

1. Wash hands.
2. Assemble equipment and clamp off rubber tubing with stopcock.
3. Attach the rectal tube to the glass connecting tip. Lubricate the tip of the rectal tube for 4 inches and place it in the emesis basin.
4. Provide privacy for patient. Fully explain the procedure to him.
5. Remove all the upper bedclothes except for one sheet or blanket to cover the patient. Place the rubber sheet under his buttocks. Turn

the patient on his left side with his right knee flexed. If he is unable to lie on his side, he may lie flat on his back.

6. Release the stopcock. Allow a small amount of the solution to run through the tubing into the emesis basin to warm the tubing and to expel air. Run small amount over hand to test temperature.

7. Clamp the tubing, either using the stopcock or pinching it tightly with fingers. Gently insert the rectal tube 4 to 6 inches into the rectum.

8. Release the stopcock and allow the solution to enter the rectum slowly. The irrigating can should be held no higher than 18 inches above the bed level.

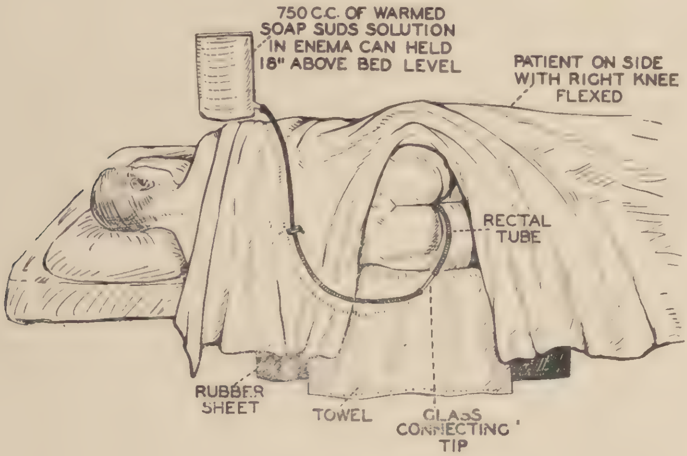


Figure 89. Cleansing enema.

9. If the patient complains of cramps, stop the flow. Instruct him to relax and breathe deeply. When he is more comfortable, resume the procedure. Stop the flow as often as necessary for the comfort of the patient until the entire amount of solution has been given.

10. Clamp the tubing. Wrap toilet paper around the rectal tube next to the anus. Withdraw the tube slowly and gently through the paper.

11. Disconnect the rectal tube and place it in the emesis basin.

12. Give patient the bedpan. Encourage him to retain the solution for five to ten minutes if possible.

13. Remove all equipment and stand by until patient has finished using the bedpan.

14. Remove bedpan and rubber sheet. Before discarding contents of bedpan, check for the effectiveness of the procedure.

15. Have patient wash hands.

16. Thoroughly wash all equipment and sterilize rectal tube and emesis basin before final storage.

17. Record the treatment and results on patient's chart.

Hour	Date	Wt.	Urine	Stool	Medications	Diet	Remarks
1000	5/28/45			√	S.S.E.		Results good. Large constipated. stool. Flatus expelled freely.

PRECAUTIONS

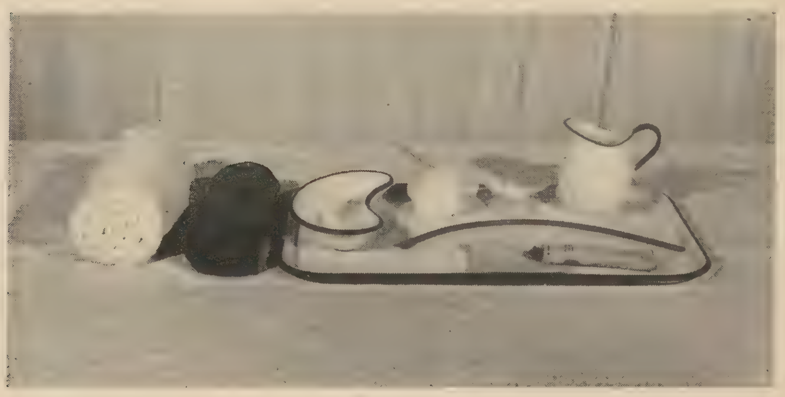
1. Inject soap solution slowly and with low pressure.
2. Insert the rectal tube no more than 6 inches.
3. Expel all air from tubing.

ENEMA; RETENTION

PURPOSE

1. To lubricate fecal mass and thus make easier the passage of a constipated stool.
2. To administer certain medications.

MATERIALS



1. Small funnel.
2. Small rectal tube or catheter.
3. Pitcher containing solution.
4. Emesis basin.
5. Rubber sheet with a towel for covering.

6. Small absorbent pad of gauze or cotton.
7. Toilet paper.
8. Lubricant.

PROCEDURE

1. Wash hands.
2. Assemble equipment and warm solution. This material must be scrupulously clean but need not be sterilized.
3. Attach the catheter to the funnel.
4. Lubricate the tip of the catheter for 4 inches. Place both the funnel and catheter in the emesis basin.
5. Prepare the patient as for a cleansing enema.
6. Pour the solution into the funnel. Allow a small quantity to run through the tubing to expel the air. Test for temperature.
7. Pinch the catheter. Insert it gently into the rectum for 4 inches.
8. Allow the solution to run in slowly.
9. Pinch the catheter and withdraw it gently into a fold of toilet paper.
10. Place the funnel and catheter in the emesis basin.
11. Using the absorbent pad, apply gentle pressure over the anus until the desire to expel the solution has passed.
12. Make the patient comfortable. Instruct him to retain the solution.
13. Thoroughly wash all equipment and sterilize catheter and emesis basin before final storage.
14. Record the treatment and results on patient's chart.

Hour	Date	Wt.	Urine	Stool	Medications	Diet	Remarks
0800	9/16/42				Retention enema mineral oil. 120 cc.		For relief of fecal impaction. Retained.
0900				√	S.S.E.		Effectual. Fecal impaction removed.
1000							Resting comfortably.

PRECAUTIONS

1. Use proper solution at proper temperature.
2. Insert solution slowly.
3. Use no more than 4 ounces (120 cc.).
4. For best results, follow an oil enema with a soap suds enema in one hour.
5. Medications that are irritating to mucous membranes should be diluted with oil.

EQUIPMENT; LUER SYRINGES, CARE OF

PURPOSE

To prevent breakage and keep the syringes in usable condition.

PROCEDURE

1. Separate barrel and plunger as soon as syringe has been used.
2. Rinse in cold water to remove blood or medication.
3. Wash in warm, soapy water using a small bottle brush or cotton tipped applicators in the barrel. Rinse in clear water.
4. Arrange barrel and plunger together according to number. Only one plunger fits each barrel. If either barrel or plunger is broken, syringe must be discarded.
5. If syringe is to be sterilized by boiling, pad the container with gauze to prevent breakage during sterilization.
6. If syringe is to be stored, dry barrel and plunger thoroughly before fitting them together.

PRECAUTIONS

1. Never boil syringe with plunger in barrel.
2. If plunger becomes stuck in barrel, boil in a solution of 3 parts water and 1 part glycerine, or allow it to stand in a weak acid solution or ether for as long as it takes the solution to seep between the barrel and plunger.

EQUIPMENT; METALWARE, CARE OF

PURPOSE

To prevent staining and chipping and to preserve the articles in usable condition.

PROCEDURE

1. Wash with cold water to remove blood and secretions.
2. Scrub with hot water and scouring powder. Rinse and dry.
3. Rub stainless steel metal with small amount of mineral oil before storing, to keep it bright.
4. Sterilize metalware by immersing in boiling water or a chemical solution for the prescribed length of time.
5. Immediately after use, rinse urinals in cold water. Wash in warm soapy water, rinse, and dry.
6. Rinse bed pans in cold water, using a toilet brush to remove feces. Wash in warm soapy water, rinse, and dry.

PRECAUTIONS

1. If only one bed pan and urinal are available for several patients, clean as directed, then soak in compound cresol solution 2.5% for twenty minutes, rinse, and dry after each use.

2. Avoid striking metalware with sharp objects. This causes chipping.

EQUIPMENT; NEEDLES, CARE OF

PURPOSE

1. To prevent rust.
2. To prevent dulling or breaking of the point.
3. To keep the lumen of the needle free from obstruction.

PROCEDURE

1. Immediately after use, attach needle to syringe filled with cold, soapy water and flush needle to remove blood or medication.

2. Repeat procedure, using clear water.

3. Repeat procedure, using alcohol 95%.

4. Examine point of needle for barbs. Test by drawing it across a piece of cotton. Remove barbs by honing on an oiled Arkansas stone. Care should be taken to preserve the desired bevel. After honing, flush needle again with alcohol 95%.

5. Protect points of needles with gauze during sterilization.

PRECAUTIONS

1. Force obstructions out of lumen of needle with wire stylet if necessary.

2. Avoid striking needles against sides of containers. This dulls the points and causes barbs.

3. Discard bent needles. They may break off in the patient if used again.

EQUIPMENT; RUBBER ARTICLES, CARE OF

PURPOSE

To prolong the life of the articles and keep them in usable condition.

PROCEDURE

Rubber Gloves

1. Wash in cold water to remove blood or secretions.

2. Wash in warm soapy water and rinse. Turn gloves inside out. Make sure both sides are clean.

3. Hang on racks or over the edge of a table to dry. Turn gloves inside out. Make sure both sides are thoroughly dry.

4. Inflate gloves with air to test for holes.

5. If gloves are to be stored, powder both sides with talcum powder and store in a dry place.

6. If gloves are to be sterilized, immerse in boiling water or a chemical solution for the prescribed length of time. Put gloves on wet.

Rubber Tubing

1. Flush tubing with cold water to remove blood, secretions, or foreign particles.

2. Wash in warm soapy water. Use applicators to clean lumen if necessary.

3. Rinse, using a syringe if necessary to flush the tubing, and hang up to dry.

4. If tubing is to be stored, coil loosely and store in a dry place.

5. If tubing is to be sterilized, immerse in boiling water for the prescribed time.

Hot Water Bags and Ice Caps

1. Test for leaks before using.

2. Drain, inflate with air, screw in stopper tightly, and dry outside of bag before storing.

3. Store in a dry place.

Rubber Sheets

1. Spread sheet on table.

2. Wash both sides with cold water to remove stains.

3. Wash both sides with warm soapy water, rinse, and hang over a rack to dry.

4. Powder with talcum powder and roll.

5. Store in a dry place.

PRECAUTIONS

1. Be sure rubber articles are clean and dry before being stored.

2. Prolonged exposure to heat deteriorates rubber. Do not dry over a radiator or store near hot pipes.

3. Oil deteriorates rubber. Be sure all oily substances have been removed before storing.

4. Never put pins in rubber goods. If they are to be wrapped for storage, secure packages with twine or paper clips.

5. Never fold rubber sheets; always roll them, preferably over a form, to prevent splitting.

6. Coil rubber tubing loosely to prevent cracks which will eventually become holes.

EYE; APPLICATION OF EYE OINTMENT

PURPOSE

1. To relieve pain.
2. To treat eye infections.

MATERIALS

1. Tube of ophthalmic ointment.
2. Absorbent cotton.

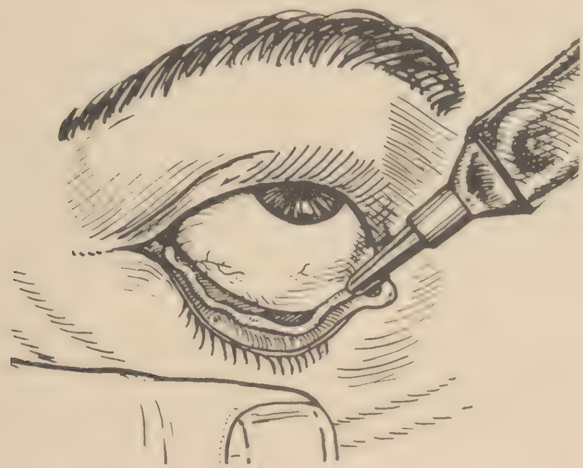


Figure 90. Application of eye ointment.

PROCEDURE

1. Evert lower lid.
2. Press ointment tube and apply thin layer of ointment to entire lower lid.

PRECAUTIONS

1. Do not touch tip of tube to eye.
2. Use only ophthalmic ointments.
3. Be sure to use the proper ointment.

EYE; INSTILLATION OF EYE DROPS

PURPOSE

1. To treat eye infections.
2. To produce local anesthesia.

MATERIALS

1. Medication to be used.
2. Medicine dropper.
3. Absorbent cotton.

PROCEDURE

1. Wash hands.
2. Wipe away any secretions from eye.
3. Draw required amount of solution, usually 1 or 2 drops, into dropper.
4. Hold dropper in vertical position so that medication will not enter rubber bulb.
5. Evert lower lid.
6. Have patient look up.
7. Hold dropper approximately one fourth inch from eye lid.
8. Place drops on lower lid near outer canthus.
9. Instruct patient to close eyes gently.
10. Wipe excess medication from face with cotton pledget.

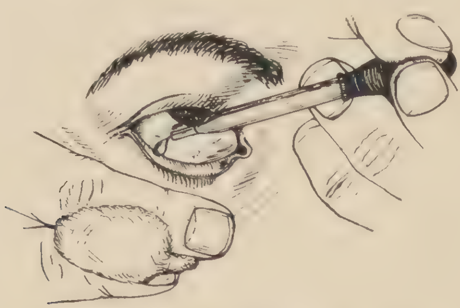


Figure 91. Administration of eye drops.

PRECAUTIONS

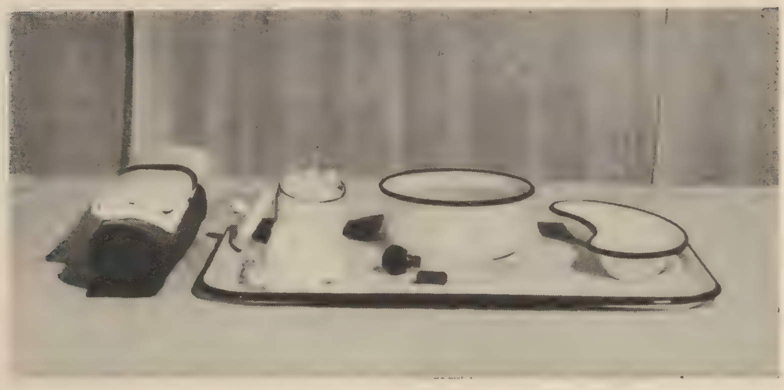
1. Be sure eye dropper is clean.
2. Do not use same dropper for different solutions.
3. Never allow dry cotton to come in contact with the eye.
4. Do not allow drop to fall on sensitive cornea.
5. Dropper must not touch lashes, lids, or eyeball.
6. Use the proper solution.

EYE; IRRIGATION OF

PURPOSE

1. To clean the eyes.
2. To treat infection or inflammation.

MATERIALS



1. Gauze sponges soaked in 4% boric acid solution.
2. Solution basin containing normal saline or boric acid solution.
3. Eye dropper or one ounce plungerless syringe.
4. Absorbent cotton.
5. Emesis basin.
6. Hand towel.
7. Small rubber sheet.

PROCEDURE

1. Wash hands.
2. Have patient sit or lie down with head tilted slightly back and turned slightly toward the affected side.
3. Drape patient with rubber sheet and towel.
4. Wipe any secretions from lids with boric acid sponge.
5. Use luke-warm solution.
6. Hold emesis basin to side of face below eye.
7. Separate lids.
8. Hold irrigator about 2 inches from the eye.
9. Irrigate gently, directing the flow of the solution against the everted lower lid. The direction of the flow is from the inner canthus to the outer canthus.
10. Refill syringe and repeat irrigation until desired results are obtained.
11. Dry lids and face with absorbent cotton.

PRECAUTIONS

1. Flow of solution should be gentle and steady.
2. When separating lids do not exert pressure on eye ball.
3. If one eye is infected, keep unaffected eye covered with clean, dry, gauze pad.

GAUZE; PETROLATUM IMPREGNATED, PREPARATION OF

MATERIALS

1. Three rolls of 3 inch gauze bandage.
2. One pound of petrolatum.
3. Covered metal instrument container, 14 inches long by 3 inches wide.
4. Bandage scissors.

PROCEDURE

1. Cut 13-inch long strips of 3 inch gauze bandage.
2. Place cut gauze bandage strips individually in the container. Fold back one end of bandage upon itself so that folded edge is on upper side of strip.
3. Melt the petrolatum and pour on the gauze strips until top layer of gauze is covered.
4. Sterilize by placing in moderately heated oven (320° F.–160° C.) for one hour.
5. When allotted time is complete, remove container from oven and pour off excess petrolatum.
6. Replace cover of container.
7. Secure cover in place with adhesive tape or bandage.

PRECAUTION

Maintain sterile precautions in handling prepared gauze after sterilization.

GAVAGE

DEFINITION

Gavage is the introduction of nourishing liquids, water, or medications into the stomach by means of a tube inserted into the esophagus via the nose or mouth.

PURPOSE

To supply foods, fluids, and medications to patients who are unable to swallow. This will ordinarily apply to unconscious, irrational, or

extremely weak patients, and those with injuries of the nose and mouth that prevent the oral intake of food.

MATERIALS

1. Tray (wood, metal, plastic).
2. Levin tube or small catheter in a basin of ice.
3. Lubricant (mineral oil).
4. Pitcher containing 4 to 10 ounces of solution 95° to 105° F. (fruit juice, milk, medications)
5. Small funnel or barrel of a syringe.
6. Rubber sheet and bath towel.
7. Emesis basin.
8. Gauze wipes.

PROCEDURE

1. Wash hands.

2. Assemble equipment and prepare solution. These materials should be scrupulously clean, but need not be sterilized.

3. Protect the bed and patient with rubber sheet and bath towel. Patient should be in a sitting or semi-recumbent position. Restrain if necessary.

4. Explain treatment to patient if possible. Try to enlist his cooperation.

5. Lubricate the end of tube. Insert it in the nostril gently. Push tube along the floor of nose back into the naso-pharynx and down into the esophagus. (If there is a nasal obstruction, tube can be introduced through the mouth.)

6. When approximately 10 inches of tube have been introduced, invert the end of tube under water in the basin of melting ice. If bubbles appear each time patient breathes, the tube is in the trachea. The Levin tube is smaller than the gastric lavage tube; consequently,

the danger of inserting it in the trachea is greater. Usually coughing, choking, or cyanosis during passage of the tube will indicate that this error has been made before much of the tube has been introduced. Should this occur, withdraw tube quickly but gently. Allow patient to rest for a few minutes before re-inserting it.

7. When the tube is in esophagus, attach the funnel or syringe barrel to tube. To lessen tendency to nausea, wait a few minutes before introducing the solution.

8. Pour solution into the funnel and allow it to run through tube at gravity flow. Hold funnel only a few inches above patient.

9. At the end of feeding, allow one ounce (30 cc.) of water to run in to flush tube.

10. Just before funnel empties, pinch tube with fingers or clamp. Withdraw gently but steadily.

11. Provide emesis basin and gauze wipes in case of vomiting after treatment.

12. Remove towel and rubber sheet.

13. Allow patient to rest after the treatment to lessen tendency to nausea.

14. Flush tube with cold water. Wash in warm soapy water and rinse. Boil for five minutes. Wash and dry remainder of equipment and put away.

15. If patient is receiving nourishment by gavage alone, feeding should be repeated every three hours. Tube can be withdrawn after each treatment or fastened with a clamp and left in place. In the latter case, fasten tube to patient's face with adhesive strips to prevent slipping out. Restrain patient's hands if necessary to prevent him from pulling it out.

16. Make a record of the treatment and results on patient's chart. Example:

Hour	Date	Wt.	Urine	Stool	Med. & Treatments	Diet	Notes
1300	3/26/45				Nasal gavage	Sweetened milk 90 cc., Eggs two, Water 60 cc.	Feeding retained.

PRECAUTIONS

1. Always insert tube gently in order to avoid injury to mucous membrane of nose, pharynx, and esophagus.

2. Be sure tube is in the esophagus and not in the trachea before introducing any fluid.

3. Pinch tube before removing it to prevent fluid from dropping into trachea.

4. Treatment is contraindicated when there is persistent vomiting or hematemesis (vomiting of blood).

HYPODERMIC INJECTION; SUBCUTANEOUS, ADMINISTRATION OF

DEFINITION

A subcutaneous hypodermic injection is the introduction of a small amount of fluid, usually medicated, into the subcutaneous tissue.

PURPOSE

1. To administer medication when prompt drug action is required.
2. To administer biological products for immunization.
3. To administer a drug the composition of which would be altered by the action of the digestive juices.
4. To administer certain drugs to patients who are unconscious, vomiting, or unable to take the medication orally because of injury or disease of the mouth.

MATERIALS

1. Sterile 2 cc. syringe containing medication.
2. Sterile ¾ inch, 24 gauge needle.
3. Alcohol sponge.

Figure 92. Administration of a subcutaneous injection.

PROCEDURE

1. Select site of injection. Areas of choice are upper outer arm and anterior thigh.
2. Disinfect the skin with the alcohol sponge.
3. Expel air from the syringe.
4. Pinch the skin to separate it from the underlying muscle. Insert

the needle ½ inch, holding the syringe parallel to the skin surface, using a single decisive motion.

5. Inject the solution.

6. Withdraw the needle quickly. Exert slight pressure over the site of the puncture with the alcohol sponge and massage gently.

7. Rinse the syringe and needle with water. Replace them in the proper containers.

8. Record the treatment on the patient's chart.

Hour	Date	Urine	Stool	Med. and treatment	Diet	Notes
0945	5/12/45			Morphine sulfate gr. ¼ (H).		For relief of pain in area of burn.

PRECAUTIONS

1. Check label of medication carefully to avoid errors.
2. Maintain sterile technique to avoid infection.
3. Introduce needle at the proper angle to avoid entering the muscle.
4. Be sure to expel all air from the syringe and needle before administration of the hypodermic.
5. Should a needle break and a portion become lost under the skin, mark the area and repeat this marking as needed until the ship reaches port and the patient can be referred to a physician. This accident will be rare and will not have serious consequences. Do not probe for the portion of the needle.

HYPODERMIC INJECTION; SUBCUTANEOUS, FRACTIONAL DOSAGE

PURPOSE

To give a dose of medicine, hypodermically, which is larger or smaller than the tablet dose available.

PROCEDURE

Dissolve the tablet or tablets in a sufficient quantity of sterile water so that the quantity to be administered measures approximately 15 minims. In so doing, it is suggested that the quantity of water used be such that the dose administered does not involve fractions of a minim.

Formula: $\frac{\text{d.d. (dose desired)}}{\text{d.h. (dose on hand)}}$ x q. (quantity of water in minims in which the tablet or tablets are to be dissolved). = d (dose to be given in minims).

Example: If the dose on hand is larger that the dose desired:
The dose desired (d.d.) is morphine sulfate grain $\frac{1}{6}$.
The dose on hand (d.h.) is morphine sulfate grain $\frac{1}{4}$.

$$\frac{\text{d.d.}\ \ \frac{1}{6}}{\text{d.h.}\ \ \frac{1}{4}} \times q = d., \qquad \frac{\frac{1}{6}}{\frac{1}{4}} = \frac{1}{6} \times \frac{4}{1} = \frac{2}{3}$$

$$\frac{2}{3} \times 24 \text{ minims} = 16 \text{ minims}$$

Answer: Dissolve one $\frac{1}{4}$ grain tablet of morphine sulfate in 24 minims of water. Discard 8 minims. The remaining 16 minims of solution contain $\frac{1}{6}$ grain of morphine sulfate.

Example: If the dose on hand is smaller than the dose desired:
The dose desired (d.d.) is morphine sulfate grain $\frac{1}{4}$.

The dose on hand (d.h.) is morphine sulfate grain $\frac{1}{6}$; thus it will be necessary to use 2 tablets.

$$\frac{\text{d.d.}\ \ \frac{1}{4}}{\text{d.h.}\ \ \frac{1}{6} \times 2} \times q = d., \qquad \frac{\frac{1}{4}}{\frac{1}{3}} = \frac{1}{4} \times \frac{3}{1} = \frac{3}{4}$$

$$\frac{3}{4} \times 20 \text{ minims} = 15 \text{ minims}$$

Answer: Dissolve two $\frac{1}{6}$ grain tablets of morphine sulfate in 20 minims of water. Discard 5 minims. The remaining 15 minims of solution contain $\frac{1}{4}$ grain of morphine sulfate.

HYPODERMIC INJECTION; SUBCUTANEOUS, MORPHINE SYRETTE

MATERIALS

1. Syrette.
2. Alcohol sponge.

PROCEDURE

1. Select proper syrette. Check label.
2. Remove transparent hood, grasp wire loop, and push wire in to pierce inner seal, turning if necessary. Avoid contaminating the needle. Pull the wire out and discard it.
3. Clean the skin with the alcohol sponge.
4. Pinch the skin to separate it from the underlying muscle. Insert the needle $\frac{1}{2}$ inch, holding the syrette parallel to the skin surface, using a single decisive motion.

5. Inject the solution by squeezing the syrette.
6. Withdraw the needle and massage the area gently with an alcohol sponge.
7. Record the treatment on the patient's chart.

PRECAUTIONS

1. Be sure to use the proper dose.
2. Tag patient recording dose and time of injection.

HYPODERMIC INJECTION; SUBCUTANEOUS, PREPARATION OF HYPODERMIC USING MEDICATION FROM A RUBBER CAPPED BOTTLE

MATERIALS

1. Rubber capped bottle.
2. Sterile 2 cc. syringe.
3. Sterile 3/4 inch 24 gauge needle.
4. Alcohol sponge.

PROCEDURE

1. Select proper bottle. Check label.
2. Disinfect top of rubber stopper by rubbing with alcohol sponge.
3. Fill the syringe with a quantity of air equal to the quantity of solution to be withdrawn.
4. Insert needle into center of stopper, and inject the air into the bottle.
5. Turn bottle upside down. Withdraw the required amount of solution.
6. Withdraw needle from bottle. Check label. Cover point of needle with an alcohol sponge until used.

PRECAUTIONS

1. Use proper medication.
2. Maintain sterile technique.

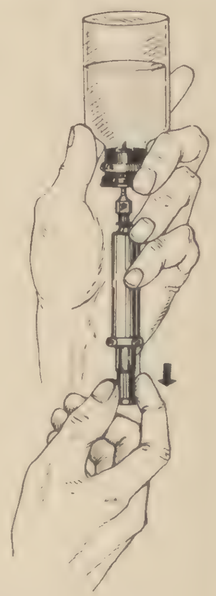


Figure 93. Withdrawal of a solution from a rubber capped bottle.

HYPODERMIC INJECTION; SUBCUTANEOUS, PREPARATION OF A HYPODERMIC USING MEDICATION FROM A SEALED AMPUL

MATERIALS

1. Ampul of medication.
2. Sterile syringe.
3. Sterile ¾ inch, 24 gauge needle.
4. Two alcohol sponges.
5. Sterile 4 x 4 compress.

PROCEDURE

1. Select proper ampul.
2. Wash hands.
3. File the neck of the ampul and wipe the top of the ampul with an alcohol sponge.
4. Break off the top of the ampul at the site of the file mark between folds of gauze compress.
5. Attach needle to syringe and aspirate solution.
6. If the medication is in powdered form (penicillin), dissolve by injecting the proper amount of sterile distilled water or sterile normal saline into the ampul.
7. Cover the point of the needle with an alcohol sponge until used.

PRECAUTIONS

1. Use proper medication.
2. Maintain sterile technique.

HYPODERMIC INJECTION; SUBCUTANEOUS, PREPARATION OF SOLUTION USING TABLETS

PURPOSE

To prepare a solution for hypodermic injection from tablet form of medication.

MATERIALS

1. Tray (metal, wood, plastic).
2. Hypodermic needle ¾ inch, 24 gauge.
3. Hypodermic syringe, 2 cc. (sterile).
4. Metal receptacle for syringe and needle, containing 70% alcohol.
5. Alcohol lamp with spoon.
6. Sterile forceps in container filled with 70% alcohol.
7. Container of alcohol sponges.
8. Medicine glass with water.
9. Emesis basin.
10. Matches.
11. Medication.

PROCEDURE

1. Select the proper medication. Check label carefully.

2. Using the sterile forceps, remove an alcohol sponge from the container and place it on the tray.

3. Using the sterile forceps, remove the needle from the container of alcohol.

4. Draw the needle over the alcohol sponge to test for barbs.

5. Place needle in spoon. Fill spoon with water. Boil for one minute.

6. Using the sterile forceps, remove the syringe from the container. Check numbers on barrel and plunger to make sure they match.

7. Using the sterile forceps, remove the needle from the spoon and attach securely to the syringe.

8. Draw a small amount of boiled water from the spoon into the syringe. Hold syringe in a vertical position, needle pointing upward. Draw the plunger back almost to the end of the barrel. Then expel the water into the waste basin. This rinses the syringe of alcohol.

9. Draw up 1 cc. (15 minims) of boiled water into the syringe. Discard the excess water from the spoon.

10. Check label on bottle containing tablets. Drop the tablet in the spoon and dissolve it by expelling water from the syringe into the spoon.

11. Draw the solution containing the medication into the syringe. Cover the point of the needle with an alcohol sponge until used. Check label of bottle containing tablets.

PRECAUTIONS

1. Use proper medication.
2. Maintain sterile technique.

HYPODERMOCLYSIS

DEFINITION

Hypodermoclysis is the introduction of a large amount of fluid into the subcutaneous tissue.

PURPOSE

To supply the body with fluids or nourishment when patient is unable to take adequate amounts of either by mouth.

MATERIALS

1. Tray (metal, wood, plastic).
2. Bottle of sterile, commercially prepared solution: 1,000 cc. normal saline or 5% glucose in normal saline.

3. Glass connecting tip.
4. One piece of rubber tubing 3 feet long and 2 pieces of rubber tubing 18 inches long.
5. "Y" glass tube.
6. Two glass adaptors.
7. Two needles 2 inches, 20 gauge.
8. Three stop cocks.
9. Alcohol sponges.
10. Two adhesive strips 4 inches long, ½ inch wide.
11. Emesis basin.
12. Four sterile towels.
13. Sterile 4 x 4 compresses.

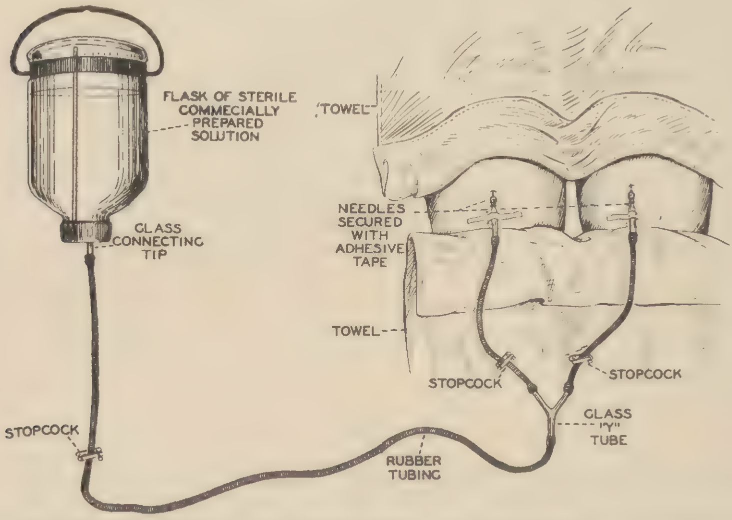


Figure 94. Diagram showing area of insertion and equipment for hypodermoclysis.

PROCEDURE

1. Attach glass connecting tip to one end of long rubber tube and the glass "Y' tube to the other end. Attach the short pieces of tubing to the free ends of the "Y" tube. Attach one adaptor and needle to the opposite ends of each of these tubes. Boil this equipment in distilled water for twenty minutes.

2. Remove from boiling water with sterile forceps and place on double thickness of sterile towels. Assemble remainder of equipment and carry to the patient's bedside.

3. Remove metal cap from bottle, pull off thin rubber seal, and insert sterile glass connecting tip into opening in stopper.

4. Attach one stop cock to each piece of tubing.

5. Invert bottle and hang it 2 feet above patient's bed.

6. Allow small amount of solution to run through tubing and needles into emesis basin. This removes air and flushes out any foreign particles that might be present.

7. Shut off flow by closing stop cock on long piece of tubing.

8. Place needles on sterile compresses until ready to use.

9. Place patient in a comfortable position (Fowler's position).

10. Fold back the bedding and select area for injection. Areas of choice are anterior thighs and loose subcutaneous tissue under breasts.

11. Disinfect the skin with alcohol.

12. Pinch up the skin and insert the needles, one in each thigh (or other area) as for a subcutaneous hypodermic injection. Continue pinching the skin until the entire length of the needle has been introduced. This will prevent insertion into a muscle.

13. Fasten the needles with adhesive strips to prevent them from slipping out.

14. Open stop cock and allow solution to run in slowly (it may take as long as four hours for 1,000 cc. of fluid to be absorbed).

15. Place two sterile towels across the areas and replace the bedding

16. Check the areas frequently for signs of edema. If necessary, shut off the flow to either side periodically, to permit absorption and prevent water-logging of the tissues.

17. If it is necessary to give more than one bottle of solution, clamp the tubing before the first bottle is entirely empty. (This prevents the entrance of air into the tube). Open the second bottle as before. Transfer glass connecting tip from first to second bottle, being careful not to contaminate the part of the connecting tip which is to be inserted into bottle. Invert bottle, hang, and regulate flow as before.

18. When required amount of fluid has been given, loosen adhesive tape, close stop cocks, and remove needles. Massage each area gently with an alcohol sponge.

19. Clean equipment and put away.

20. Chart treatment on patient's record.

Hour	Date	Wt.	Urine	Stools	Medications	Diet	Remarks
1400	6/9/44					Sips of water	Admitted to sick bay after rescue from lifeboat. Complained of thirst and eyes burning. Skin dry and wrinkled. Mouth dry. Lips cracked.
1430					Hypodermoclysis 1000 cc. normal saline.		Started in thighs.
1730							Treatment completed. Fluid was absorbed quickly.

PRECAUTIONS

1. Maintain sterile technique to avoid infection.
2. Prevent introduction of air into tissues by allowing solution to run through tubing and needles before starting treatment.
3. Prevent water-logging of the tissues by checking the areas frequently for indications that absorption is not taking place (exaggerated swelling, pitting of the skin on pressure).
4. The means by which the bottles of sterile solution are connected to the rubber tubing vary with each manufacturer. Check equipment and make necessary adjustments.

INSTILLATION OF MEDICATIONS AND IRRIGATION OF THE URINARY BLADDER

PURPOSE

1. To cleanse the bladder.
2. To apply heat to the bladder lining.
3. To apply a drug to the lining of the bladder.

MATERIALS

1. All necessary materials for simple catheterization.
2. Extra hemostat or tubing clamp.
3. Large sterile plungerless syringe.
4. Sterile basin containing medication or 500 cc. of sterile irrigating solution.

PROCEDURE

1. Wash hands.
2. Perform catheterization and leave catheter in place after urine has stopped flowing.

3. Fill the plungerless syringe with irrigating solution, insert the syringe into the end of the catheter, and gently inject the irrigating solution.

4. Remove syringe from the catheter and pinch off catheter with hemostat or tubing clamp. Allow solution to remain in bladder for two to three minutes, then drain.

5. Repeat the procedure until the fluid returns clear or until practically all the irrigating solution has been used.

6. Before removing catheter, instill 50 cc. of irrigating solution and allow this to remain in the bladder.

7. Leave patient dry and comfortable. Clean, sterilize, and store all used equipment.

8. Record procedure on patient's chart.

PRECAUTIONS

1. This is a sterile procedure. Maintain proper technique throughout.

2. Never attempt to aspirate irrigant solution from the bladder. Let it run out normally.

INTRAMUSCULAR INJECTION

DEFINITION

An intramuscular injection is the injection of a small amount of fluid, usually medicated, into the muscle.

PURPOSE

1. To administer a substance that would be irritating if given subcutaneously (bismuth preparations).

2. To obtain a more prompt and reliable action than that which results from subcutaneous or oral administration (penicillin).

MATERIALS

1. Proper medication or biological preparation.
2. Sterile syringe.
3. Sterile needles either ¾ inch, 24 gauge, or 2 inch, 20 gauge.
4. Alcohol sponge.

PROCEDURE

1. Load syringe with proper dose of proper medication.

2. Disinfect the site of injection with alcohol sponge. The upper outer quadrant of the buttock is preferred; if this is unsuitable use the deltoid muscle. When the buttock is used, have the patient lean over a table supporting part of his weight on his elbows. If it is inadvisable for the patient to stand, he should be in a prone position.

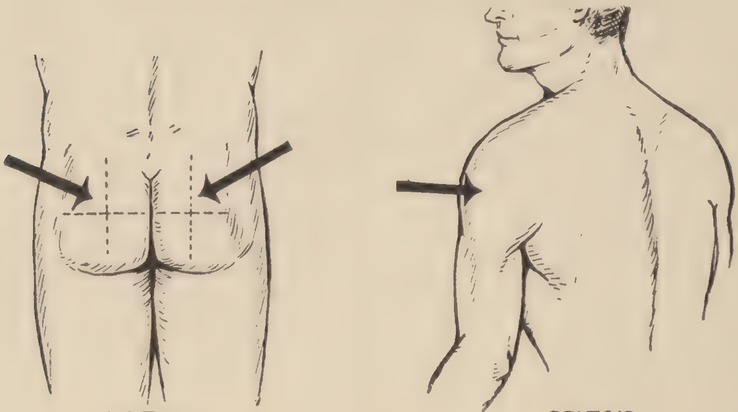


Figure 95. Preferred sites for intramuscular injection.

3. Stretch the skin tightly over the proposed site of injection and with the needle perpendicular to the skin, insert with a single, decisive thrust.

4. Pull back on the plunger slightly to see if blood enters the syringe. Look for blood at the junction of the needle and the syringe. If blood is not aspirated, inject solution slowly. If blood *is* aspirated, withdraw the needle a short distance and again aspirate. If no blood appears, proceed with injection. If blood again appears, withdraw needle and use another site.

5. Withdraw needle with a single motion and rub the site of injection with the alcohol sponge.

6. Rinse needle and syringe with water.

7. Record treatment on patient's chart.

PRECAUTIONS

1. Use proper medication.

2. Maintain sterile technique.

3. Do not inject solutions into blood vessels or nerves. Blood will be aspirated into the syringe if the needle is in a blood vessel. Pain will be felt down the leg if needle is too near a nerve. Both of these accidents can be prevented by choosing the proper site of injection.

4. If it is necessary to give repeated injections, alternate the sites.

5. Should a needle break and a portion become lost under the skin, mark the area and repeat this marking as needed until the ship reaches port and the patient can be referred to a physician. This accident will be rare and will not have serious consequences. Do not probe for the portion of the needle.

INTRAVENOUS INFUSION

DEFINITION

An intravenous infusion is the introduction of a large amount of fluid into a vein.

PURPOSE

1. To supply fluids and nourishment to a patient who is unable to take adequate amounts by mouth.
2. To restore blood volume following hemorrhage and in shock.

MATERIALS

1. Tray (wood, metal, plastic).
2. Bottle of commercially prepared solution: 1000 cc. 5% glucose in normal saline or 250 cc. plasma at room temperature.
3. Drip indicator.
4. One piece of rubber tubing 5 feet long.
5. One glass adaptor.
6. One stop cock.
7. One needle 2 inches, 20 gauge.
8. Tourniquet.
9. Two adhesive strips 4 inches long, ½ inch wide.
10. Alcohol sponges.
11. Armboard (padded basswood splint).
12. Two strips of one inch bandage, 24 inches long.
13. Emesis basin.
14. Two sterile towels.
15. Sterile 4 x 4 compress.

PROCEDURE

1. Insert short end of drip indicator into one end of the rubber tubing, and the wide end of the adaptor into the other end of the rubber tubing. Attach needle to adaptor. Boil this equipment in distilled water for twenty minutes.

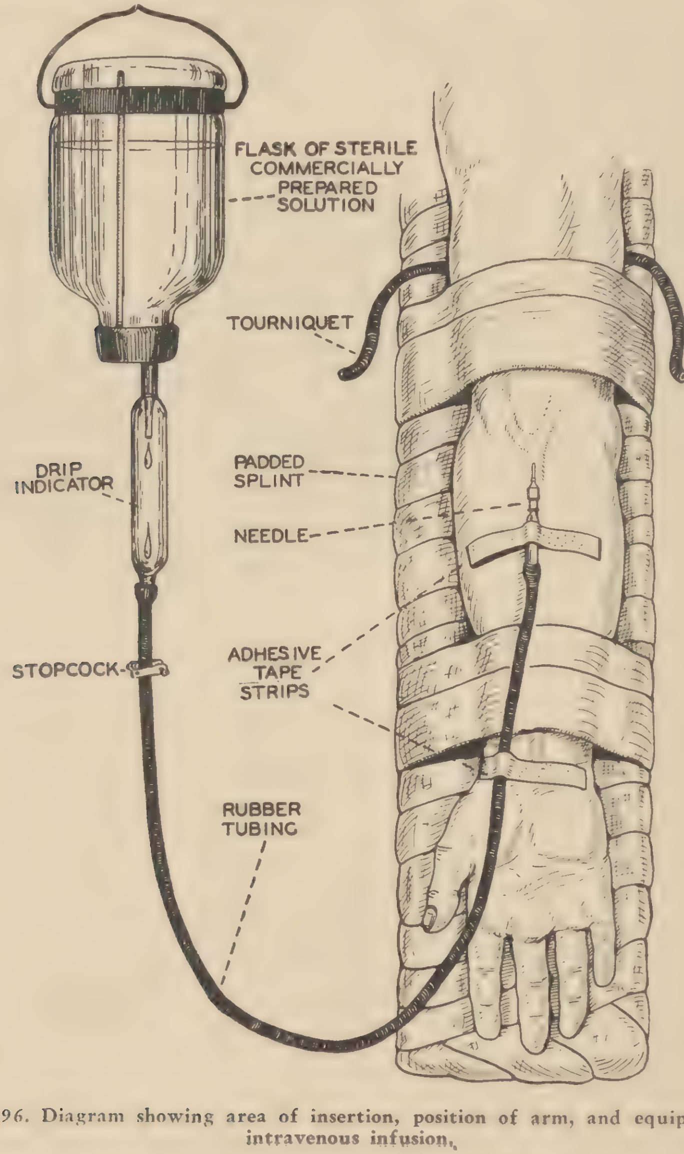


Figure 96. Diagram showing area of insertion, position of arm, and equipment for intravenous infusion.

2. Remove from boiling water with sterile forceps and place on double thickness of sterile towels. Assemble remainder of equipment and carry to the patient's bedside.

3. Remove metal cap from bottle, pull off thin rubber seal, and insert sterile drip indicator into opening in stopper of solution bottle.

4. Attach the stop cock to the tubing.

5. Invert bottle and hang it 2 feet above patient's bed.

6. Allow about 50 cc. of solution to run through tubing and needle into emesis basin. This removes air and flushes out any foreign particles that might be present.

7. Place needle on sterile compress until ready to use.

8. Select a large, prominent, straight vein near the elbow.

9. Tie the arm loosely to the arm board with gauze bandage above the elbow and at the wrist.

10. Apply tourniquet well above the elbow, using a quick release loop.

11. Disinfect the patient's skin, wiping over the vein first then on either side of it.

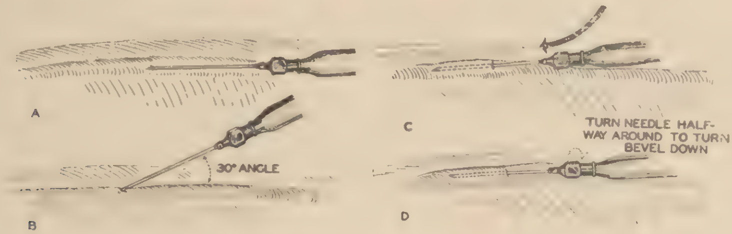


Figure 97. Method of inserting a needle into a vein.

12. Hold the needle adaptor by the sides between the thumb and fingers, so that the bevel of the needle is up and the shaft of the needle is nearly parallel to the skin.

13. Insert the needle into skin, at the lower end of the vein, far enough to cover the bevel.

14. Raise the needle so that it makes an angle of approximately 30° with the vein. The more superficial the vein, the smaller the angle should be. Be sure the shaft of the needle is in line with the vein. Push the needle forward with a steady, firm motion to insert the point into the vein. Indications that the vein has been successfully punctured are a definite "pop," lack of resistance to the needle point, and flow of blood into the glass adaptor.

15. Decrease the angle between the needle and the vein and advance the needle point one inch up the channel of the vein. Turn needle halfway around so that the bevel is facing down.

16. Release the tourniquet.

17. Open stop cock and adjust flow to 90 to 120 drops per minute. It may take as long as two hours for the administration of 1000 cc. of fluid. Plasma is administered as rapidly as tubing will allow and no stop cock adjustment is necessary.

18. Secure glass adaptor to arm with adhesive strip.

19. Secure tubing to wrist with adhesive strip.

20. If it is necessary to use more than one bottle of solution, close the stop cock before the first bottle is completely empty. Open the second bottle and transfer the drip indicator from the first bottle to the opening in the second bottle. Invert bottle, release stop-cock, and adjust flow as before.

21. When the treatment is completed, close stop cock, remove tape from adaptor and tubing, withdraw needle from arm, and exert pressure with an alcohol sponge over site of puncture for about three minutes. The patient may be able to do this.

22. Remove arm board.

23. Rinse tubing, drip indicator, and adaptor with cold water to remove blood and solution. Flush needle with cold water using a syringe. Clean and store all equipment.

24. Record treatment and results on patient's chart.

Hour	Date	Wt.	Urine	Stools	Medication	Diet	Remarks
1400	10/17/45						Unable to retain food or liquids.
1430					Intravenous infusion of 5% glucose in normal saline, 1000 cc.		Started.
1630							I. V. completed. No reaction.

PRECAUTIONS

1. Maintain sterile technique to prevent infection.

2. Administer solution at room temperature.

3. Be sure to expel air from tubing and needle before puncturing vein.

4. If the first attempt to puncture a vein is unsuccessful, withdraw the needle until just the bevel is covered by the skin and make other attempts to enter the vein.

5. Check for signs of swelling around the needle. This indicates that the needle has slipped out of the vein and the fluid is running into the subcutaneous tissue. Should this occur, withdraw the needle and discard

it. Using a sterile needle, begin the infusion in a vein in the other arm.

6. If the needle is apparently in place but the solution fails to flow freely, check to make sure the stop cock is open and the tourniquet released. Unless the needle is obstructed, blood should flow into the adaptor if the tubing is "milked" from the needle toward the bottle.

7. The means by which the bottles of sterile solution are connected to the rubber tubing vary with each manufacturer. Check equipment and make necessary adjustments.

ISOLATION UNIT; CONCURRENT AND TERMINAL DISINFECTION

DEFINITION

The area immediately surrounding the patient is considered the "Isolation Unit." It includes all furniture as well as materials necessary for the care of the patient with a contagious disease. Everything within the unit is considered contaminated.

Concurrent disinfection is the prompt disinfection and disposal of all infective materials throughout the course of the disease.

Terminal disinfection comprises the measures taken to prevent the spread of the disease after the termination of the disease.

PURPOSE

To prevent spread of contagious disease.

MATERIALS

1. Basin of 1% compound cresol solution.
2. Paper towels.
3. Clothes tree.
4. Isolation gown.
5. Waste paper container.
6. Bed pan.
7. Urinal.
8. Wash basin.
9. Soap and soap dish.
10. Necessary toilet articles.
11. Bottle of rubbing alcohol.
12. Emesis basin.
13. Bottle of mouth wash.
14. Thermometer and container with disinfecting solution (70% alcohol).
15. Mouth wipes.
16. Paper bags.
17. Garbage pails—3 large.
18. Compound cresol 2.5% solution.
19. Chlorinated lime (concentrated solution, one-half pound per gallon of water).

PROCEDURE

1. Put on gown.

2. Proceed into unit and carry out all nursing care and necessary treatments.

3. Disinfect contaminated materials in the following manner before they leave the unit:

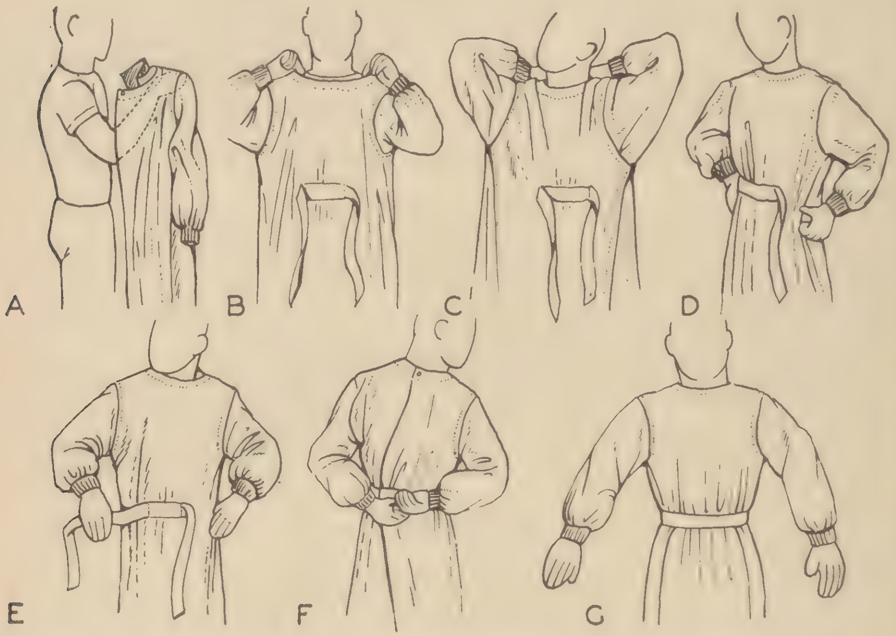


Figure 98. Method of putting on previously used gown without contaminating the clothing of the wearer.

Soiled linens: soak in 2.5% compound cresol solution for thirty minutes, wring well, remove from unit, and send to laundry.

Dishes, metal and enamel utensils: scrape well, then soak in 2.5% compound cresol solution for thirty minutes. Remove from unit.

Food scraps and body excreta: disinfect urine, feces, vomitus, and food scraps in covered container, using an equal quantity of chlorinated lime solution. Allow to stand for two hours before disposal. Sputum and mouth wipes: place in paper bags and burn.

Rubber materials (rubber sheets, hot water bottles, ice caps, and tubing): wipe with 2.5% compound cresol solution. Remove from isolation unit, wash with soap and water, and dry before storing.

Mattress, pillow, room furnishings: wipe well with cloth wet with 2.5% compound cresol solution, and air for twenty-four hours before using. (Terminal Disinfection.)

Thermometers: clean thoroughly with soap and water. Soak in disinfecting solution (70% alcohol) for thirty minutes. (Terminal Disinfection.)

4. Wash hands in basin containing 1% solution of compound cresol.

5. Remove gown.

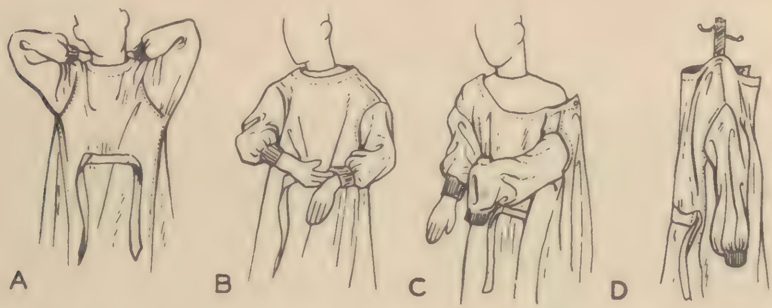


Figure 99. Method of removing and hanging contaminated gown without contaminating the clothing of the wearer and without contaminating the inner surface of the gown.

PRECAUTIONS

1. Face the patient as little as possible.
2. Keep hands away from face.
3. Have patient keep mouth covered while coughing or sneezing, or provide a mask for him.

LAVAGE; GASTRIC

DEFINITION

Gastric lavage is the irrigation or washing out of the stomach by means of a tube passed through the mouth into the esophagus and stomach.

PURPOSE

1. To remove irritating substances or poisons from the stomach.
2. To relieve gastric distention.
3. To relieve persistent vomiting.

MATERIALS

1. Tray (metal, wood, plastic).
2. Stomach tube, with rubber funnel attached, in a basin of ice.
3. Lubricant (mineral oil).
4. Rubber sheet and bath towel.
5. Pitchers containing 4 to 8 quarts of solution warmed to 95° to 105°F. (normal saline, 4% soda bicarbonate solution, tap water or a specific antidote for a poison).
6. Pint graduate or substitute.
7. Large wash basin for return flow.
8. Emesis basin.
9. Gauze wipes.

PROCEDURE

1. Wash hands.

2. Assemble equipment and prepare solution. These materials should be scrupulously clean, but need not be sterilized.

3. Protect bed and patient with rubber sheet and bath towel. Patient should be in a sitting or semi recumbent position if possible. Restrain if necessary.

4. Explain treatment to patient and try to enlist his cooperation.

5. Lubricate end of tube. Place it far back in mouth.

6. Instruct patient to swallow tube. Give few sips of water if necessary to facilitate this. If patient is unconscious, push tube down gently with each involuntary swallow.

7. When approximately 16 inches of tube have been introduced, invert the funnel under water in basin of melting ice. If bubbles appear each time patient breathes, tube is in trachea. Usually coughing, choking, and cyanosis during passage of tube will indicate that this error has been made before much of the tube has been introduced. If so, withdraw tube quickly, but gently. Allow patient to rest for short time before reinserting tube.

8. When you are sure tube is in stomach, introduce one pint of solution, holding funnel about 12 to 18 inches above patient.

9. Just before funnel becomes empty, invert it over wash basin, which is on the floor or on a chair lower than bed level. The principle involved is siphonage.

10. Repeat procedure until returning fluid is clear.

11. Pinch tube with fingers or a clamp before withdrawing.

12. Withdraw tube gently but steadily.

13. Provide an emesis basin and gauze wipes for patient in case nausea or coughing follow treatment.

14. Remove towel and rubber sheet. Make patient comfortable.

15. Examine stomach contents before discarding.

16. Flush stomach tube with cold water. Wash in warm soapy water and rinse. Boil for five minutes.

17. Wash and dry remainder of equipment and put away.

18. Make a record of the treatment and results on patient's chart. Example:

Hour	Date	Wt.	Urine	Stool	Med. and treatment	Diet	Notes
1300	3/22/45				Gastric lavage with normal saline.		For relief of persistent vomiting. Stomach contents light yellow. Few small particles of undigested food. Shreds of mucus.

PRECAUTIONS

1. Always insert tube gently in order to avoid injury to mucous membrane of pharynx and esophagus.

2. Be sure tube is in esophagus and not in trachea, before introducing any fluid.

3. Pinch tube before removing, to prevent fluid from dropping into trachea.

4. Do not attempt to pass a stomach tube if patient is vomiting blood.

MEDICATION; PREPARATION AND ADMINISTRATION OF

PURPOSE

To accurately prepare and administer the proper medication.

MATERIALS

1. Tray (wood, metal, plastic).
2. Medicine cards.
3. Medicine glasses.
4. Small pitcher of cold water.
5. Gauze wipes.
6. Medicine droppers, if administering medicines measured in drops.
7. Drinking tubes, if administering medicines containing iron or acids.

PROCEDURE

1. Set up a medicine card system. Each card should contain the patient's name, bunk number, medication to be given, and hours due.

Bunk #4	Smith, John
Sulfadiazine Gm. 1	
0800–1200–1600	
2000–2400–0400	

2. Keep materials together on the medicine tray.

3. Place the cards side by side on the tray so that the name of the drug can be readily seen. As each dose is prepared, place the medicine glass on the proper card.

4. Read label of medicine bottle three times in a good light: first, upon removing from the medicine chest; second, before measuring medicine, check with medicine card; and third, upon returning bottle to medicine chest.

5. To prepare liquid medication, shake well and hold bottle with label against palm of hand to pour. Hold medicine glass at eye level and mark correct measurement on glass with thumb nail. Pour liquid until the bottom of meniscus or concave surface of liquid reaches exact marking. Wipe top of bottle with gauze.

6. Dilute liquid medicines with water to at least one half ounce unless contraindicated. Preparations containing iron or acid are diluted with water to one half glass and given through a drinking tube. Cough syrups and bitters are given undiluted.

7. Place pills, tablets, or capsules into cap of container, then transfer them to a medicine glass. Administer as prepared and follow with water. If patient has difficulty swallowing, crush tablets or pills and dissolve in small amount of fruit juice or water. Dissolve powders in water or fruit juice.

8. Give oily preparations iced. Mix with a small amount of fruit or vegetable juice to disguise the taste.

9. When all of the medicines have been prepared, carry the medicine tray to each bunk and give each patient his medicine. Check each name carefully with the name on the medicine card. Stay with each patient until he has taken the medicine.

10. After all the medicines have been distributed, wash, dry, and store the equipment.

11. Record the medicine and the time it was given on each patient's chart.

PRECAUTIONS

1. Never use medicine from an unlabelled container.

2. Discard all medicines that show signs of deterioration. This will be evidenced usually by a change in color or odor.

3. Check medicine cards daily and make out new cards as medicines or the time of their administration are changed. If a patient is transferred from one bunk to another, be sure to change the number of his medicine card.

4. Keep bottles clean and labels legible.

5. Keep a careful record of all narcotics which are administered.

6. Respect patient's word if he states he has an idiosyncracy to a drug.

7. Observe patient closely if he shows unusual effects from the medicine. A knowledge of the maximum and minimum dosage and early signs of toxic effect of certain drugs is essential in order to intelligently administer medicines.

MEDICATION; RECTAL SUPPOSITORY, ADMINISTRATION OF

DEFINITION

A rectal suppository is a cone-shaped solid which may consist of soap, glycerine, or plain or medicated cocoa butter. When introduced into the rectum it melts.

PURPOSE

1. To bring about the expulsion of feces from the rectum.
2. To relieve painful hemorrhoids.

MATERIALS

1. Suppository.
2. Lubricant.
3. Rubber glove.
4. Toilet tissue or gauze.

PROCEDURE

1. Select proper suppository.
2. Assemble equipment.
3. Explain treatment to patient and turn him on his side if possible.
4. Put on rubber glove.
5. Lubricate suppository and, with a gloved finger, insert cone pointed end first into rectum as far as finger will reach.
6. Apply pressure over anus for a few minutes until desire to expel suppository has passed.
7. Wash, sterilize, and store the rubber glove.
8. Record treatment on patient's chart.

PRECAUTIONS

1. Never use force when inserting suppository.
2. Store suppositories in a cool place to prevent melting.

MEDICATION; STEAM INHALATION, ADMINISTRATION OF

PURPOSE

1. To relieve inflammation and congestion of the upper respiratory tract.
2. To loosen secretions and relieve cough.

MATERIALS

1. Basin, pitcher, or standard steam inhalator containing medicated solution: one teaspoonful tincture benzoin to one pint of water.
2. ¼ teaspoonful of salt.
3. Electric hot plate.
4. Four sheets.
5. Rubber sheet.
6. Four bath towels.

PROCEDURE

1. Assemble equipment.
2. Boil the water and add medication and salt. Turn heat regulator to "Low" so that solution continues to boil.
3. Spread rubber sheet under mattress of upper bunk to protect it from moisture.
4. Fold one sheet hem to hem and tuck one end under mattress of upper bunk at the head of the bunk. Tuck free end under mattress of lower bunk.

5. Fold each of the other sheets the same way and tuck in place on either side of the head of the bunk.

6. Line the canopy with bath towels to absorb moisture.

7. Direct flow of steam into enclosure.

8. If patient is ambulant he may sit in a chair with one sheet thrown over him and the pitcher, tent fashion.

9. This treatment is usually continued for twenty minutes and is repeated three times daily.

10. It is not necessary to make a fresh supply of solution for each treatment. Add water and medication in the proper proportion as the solution evaporates.

11. When treatment is discontinued, clean container with 95% alcohol to remove encrusted tincture of benzoin.

12. Record the treatment on the patient's chart.

PRECAUTIONS

1. Direct flow of steam away from patient to avoid burning.

2. Keep patient warm during and after treatment. If patient is ambulant, do not allow him to go outdoors for at least two hours after the treatment.

3. Place container of boiling solution well out of patient's reach to prevent him from touching it and burning himself.

NOSE; INSTILLATION OF NOSE DROPS

PURPOSE

1. To relieve nasal congestion.
2. To apply mild antiseptic solutions.

MATERIALS

1. Nose drops.
2. Medicine dropper.

PROCEDURE

1. Have patient tilt his head backward while he is sitting down or lying on his back.

2. Fill medicine dropper with required dose.

3. Empty the nose drops into each nostril with the tip of the dropper inserted just inside the nostril.

4. After drops have been inserted, have patient, if possible, bend forward until his head is between his knees. He should retain this position for fifteen to thirty seconds.

PRECAUTION

The position of the patient, rather than the force with which the drops are inserted, determines how much nasal mucosa will be affected by medication.

PROCTOCLYSIS (MURPHY DRIP)

DEFINITION

Proctoclysis is the introduction of a large amount of fluid into the rectum, at a very slow rate, for the purpose of absorption.

PURPOSE

1. To supply fluids to the body.
2. To provide nourishment.

MATERIALS

1. Irrigating can with rubber tubing.
2. Stopcock.
3. Murphy drip bulb.
4. Catheter with a glass connecting tube.
5. Rubber sheet for bed with towel for covering.
6. Emesis basin.
7. Hot water bottle.
8. Lubricant.
9. 1,000 cc. (1 quart) of warmed solution: normal saline, glucose 2½%, tap water.

PROCEDURE

1. Give a cleansing enema two hours before this treatment.
2. Wash hands.

3. Assemble equipment and prepare solution. These materials should be scrupulously clean but need not be sterilized.

4. Clamp stopcock above Murphy drip bulb.

5. Lubricate tip of catheter for approximately six inches.

6. Prepare patient as for cleansing enema. Since treatment will be continued over a period of hours, the patient must be made as comfortable as possible.

7. Hang irrigating can 2 feet above patient's bed.

8. Allow a small amount of solution to run through tubing into the emesis basin to warm the tubing and expel air. Run small amount over hand to test temperature.

9. Regulate flow of solution through Murphy drip bulb at 40 to 60 drops a minute.

10. Clamp catheter tightly between fingers. Gently insert it about 6 inches into rectum. Release fingers and again check rate of flow. Secure catheter in place by taping it across buttocks. Place hot water bottle on bed over tubing.

12. Check apparatus at frequent intervals for leaks. Change hot water bottle as often as necessary to maintain the proper temperature of the solution.

13. When treatment has been completed, wash equipment. Sterilize catheter and emesis basin before final storage.

14. Record treatment and results on patient's chart.

Hour	Date	Wt.	Urine	Stools	Medications	Diet	Remarks
0800	9/16/42					Sips of water ad lib	Face flushed. Skin dry and hot. Tongue cracked and furry. Intense thirst.
0830					Proctoclysis 1000 cc. normal saline.		Proctoclysis started.
1100							Resting more comfortably. Retained fluid. Position changed.
1400							Proctoclysis completed. Retained.

PRECAUTIONS

1. Be sure that solution is at proper temperature.

2. Be sure solution is given at the proper rate of flow.

3. If patient complains of discomfort, stop treatment for fifteen minutes and check set-up.

REDUCTION OF DISLOCATED JAW

PURPOSE

To restore the normal articulation of a dislocated jaw.

MATERIALS

1. Four-tailed bandage.
2. Gauze roller bandage, 2 inches wide.

PROCEDURE

1. Wrap gauze roller bandage around each thumb.
2. Have patient sit facing you with his knees spread apart. Stand in front of patient, between his knees, and facing him.
3. Place each padded thumb on the rearmost, lower teeth on each side of the lower jaw. Cup the four fingers of each hand on each side of the outer lateral portion of the jaw.
4. Apply a steady downward and backward pressure on the lower jaw. When reduction occurs, a sharp click may be felt.
5. Apply the four-tailed bandage for a few days and caution the patient not to open the mouth widely for a period of ten days.

PRECAUTIONS

1. Be sure that the thumbs of the operator are well padded to avoid injury.
2. Attempt to reduce the jaw as soon as possible after initial dislocation.

REDUCTION OF DISLOCATED SHOULDER

PURPOSE

To restore the normal articulation of the shoulder.

MATERIALS

1. Table or canvas hammock.
2. Weight of approximately 10 pounds.
3. Cotton padding.
4. Elastic or gauze roller bandage, 4 inch width.
5. Triangle bandage.
6. Adhesive tape.

PROCEDURE

1. Place the patient on his abdomen at full length on a table. Bring the injured side of the patient to the edge of the table.
2. Pad the axilla and chest so that the pressure of the edge of the table is more widely distributed.

3. Allow the injured extremity to hang straight down from the table and attach the weight to the hand, as illustrated.

4. Allow the patient to remain in this position until the dislocation is reduced. This may require several hours.

5. Keep the patient as comfortable as possible during this procedure. The table may be made more comfortable by covering it with a thin mattress or other padding. Pain may be sufficiently intense to require morphine.

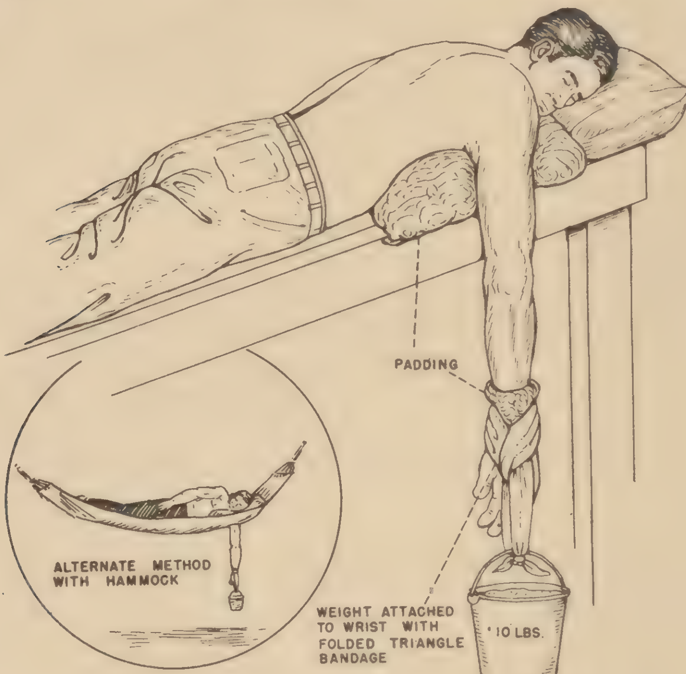


Figure 100. Method for the reduction of a dislocated shoulder.

6. If reduction of the dislocation has not been achieved after several hours, a slight outward rotation of the extremity may accomplish the reduction.

7. A canvas hammock, in which a hole has been cut so that the patient may lie on his side with the injured extremity hanging straight down from the body, is superior to the table in certain respects.

8. Apply a Velpeau bandage for 10 days after reduction of the dislocation.

PRECAUTIONS

1. Handle injured extremity carefully.
2. Avoid undue pressure on the axillary area.

RESTRAINTS

DEFINITION

A restraint is the forcible restriction of a patient.

PURPOSE

1. To prevent a patient from injuring himself or others.
2. To prevent a patient from getting out of bed.

MATERIALS

1. Sideboards (metal, canvas, or wooden).
2. Sheets.
3. Bandages.
4. Leather cuffs, anklets, strops.
5. Canvas restraint sheet.
6. Straight jacket.

PROCEDURE

Sideboards

Sideboards should be approximately 18 inches wide and should extend the length of the bed frame. Fasten each board securely to head and foot of bed.

If wooden or metal sideboards are used they must be well padded with blankets to prevent injury.

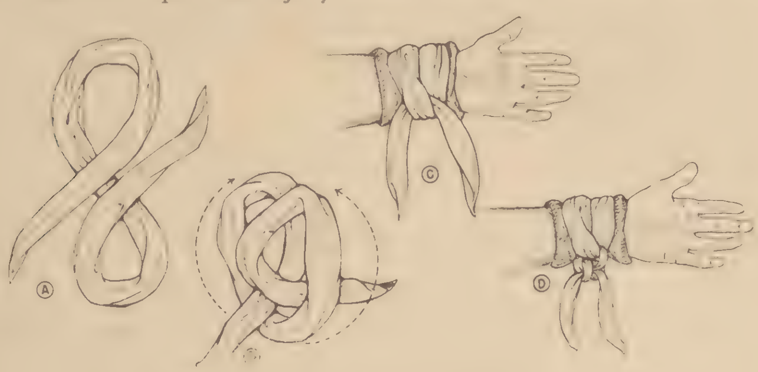


Figure 101. The clove hitch applied to the wrist.

Nelson Restraint (using sheet)

Fold sheet diagonally and roll.

Place center of rolled sheet under patient's neck.

Bring ends of sheet over the shoulders and under the arms (pad axilla well).

Cross ends of sheet under pillow.

Tie ends of sheet securely to head of bed.

Clove Hitch Ties for Hands and Feet (use thick, soft bandages)

Make the clove hitches and secure about padded wrists and ankles.

Tie a square knot in each bandage below the hitch and secure to bunk.

Mummy Restraint (using blanket or heavy canvas)

Place patient lengthwise on a piece of canvas eight feet square (a blanket may be substituted). Edge of material should be even with shoulder line.

Place patient's right hand, palm down, under his buttock.

Bring canvas across patient's body from right to left and tuck it securely under his body, leaving left arm free.

Place left hand, palm down, under left buttock.

Wrap canvas from left to right, pull snugly and pin securely in several places.

Fold excess canvas at bottom up over feet and pin securely.

Straight Jackets and Canvas Restraint Sheet

Apply these restraints as specified by the manufacturer.

PRECAUTIONS

1. Never apply a restraint unless it is absolutely necessary.
2. Before applying any restraint, other than sideboards, obtain permission from the master of the ship.
3. Make restraint effective. A poor restraint is worse than none at all.
4. A restrained patient needs careful nursing care and gentle handling.
5. Never fasten hands to head of bunk. Never fasten both hands to the same side of bunk.
6. Do not apply a restraint so that it interferes with breathing.
7. Inspect restraint at frequent, regular intervals.

SPLINT; BASSWOOD, APPLICATION TO FOREARM

PURPOSE

To immobilize the forearm in the presence of a suspected fracture.

MATERIALS

1. Two basswood splints.
2. Cotton.
3. Four rolls of 3 inch gauze bandage.
4. Roll of 2 inch adhesive tape.
5. Triangle bandage.

PROCEDURE

1. Trim both basswood splints so that they will extend from the metacarpo-phalangeal joints to 2 inches beyond the elbow.

2. Pad the splints with cotton, so that one conforms to the contour of the anterior surface of the forearm and the other to the posterior surface. Wrap well with gauze bandage to hold padding in place.

3. With the aid of an assistant, flex the forearm, so that it forms a right angle with the arm.

4. Apply the padded splints to the forearm in such a way that the palm of the hand directly faces the body. The splints should extend from the metacarpo-phalangeal joints to 2 inches beyond the elbow.

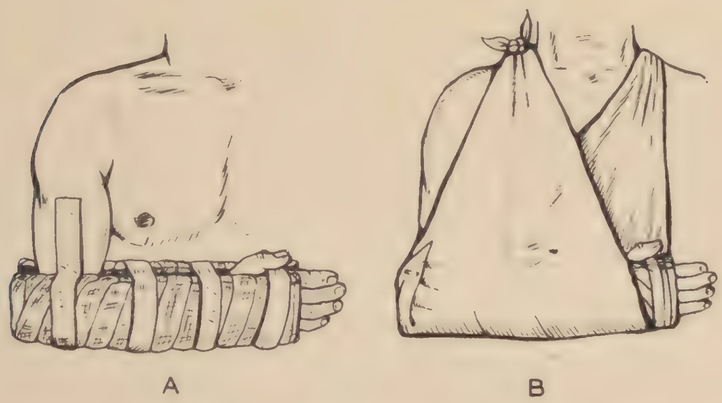


Figure 102. Basswood splint applied to forearm.

5. Secure the splint firmly in place by completely encircling the splints with adhesive tape at the palm of the hand, about 2 inches above the wrist, and about 2 inches below the elbow. Another strip of adhesive is applied from the middle of the arm on its outer surface, around the two splints at the elbow, and back up to the middle of the inner surface of the arm.

6. Bandage the splinted forearm.

7. Place splinted forearm in sling.

PRECAUTIONS

1. Do not aggravate injury by rough handling.

2. Apply splint so that the forearm is not capable of rotation, nor should motion in the wrist joint be possible.

3. Observe hand and fingers frequently for evidence of circulatory disturbance, and loosen or reapply splint if necessary.

4. As splint becomes loosened, it should be reinforced.

SPLINT; BOX, APPLICATION OF

PURPOSE

To immobilize the lower extremity in the presence of a suspected fracture.

MATERIALS

1. One board, 4 inches wide, ½ inch thick, extending along back of lower extremity from heel to above buttock.
2. One board, 4 inches wide, ½ inch thick, extending along inner side of lower extremity from heel to groin.
3. One board, 4 inches wide, ½ inch thick, extending along outer side of lower extremity from heel to a point 6 inches below axilla.
4. Cotton padding.
5. Gauze bandage, 4 inches wide.
6. Adhesive tape, 3 inches wide.

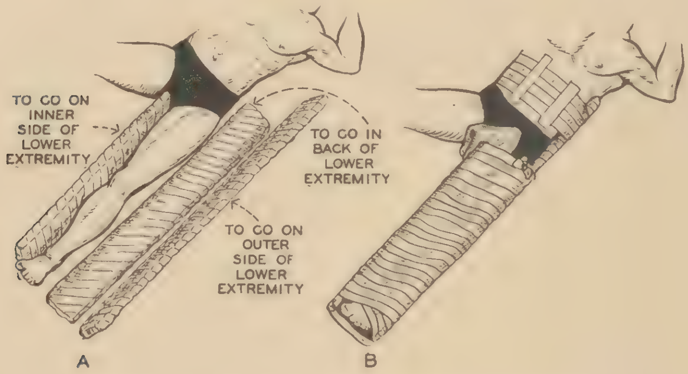


Figure 103. Box splint applied to lower extremity.

PROCEDURE

1. Fit each board to its anticipated location and pad generously with cotton and secure padding in place with gauze roller bandage. The padded splint should conform to the contour of the lower extremity.
2. Reinforce padding over all bony prominences and place large pad in groin.
3. Secure padded splints in position with strategically-placed, encircling strips of adhesive tape.
4. Tighten the splints by applying a gauze roller bandage from the heel to the groin and attach the lateral splint to the trunk of the body by a few turns of bandage reinforced with adhesive tape.

PRECAUTIONS

1. Apply the splint in such a way that the foot is at right angles to the long axis of the leg.
2. Make sure that all bony prominences and the groin are heavily padded.
3. Observe foot at frequent intervals to check for adequate circulation.
4. Pillows may be substituted for cotton padding.
5. Fractures of the ankle, leg, and kneecap may be immobilized by a similar splint that extends halfway up the thigh.

SPLINT; FINGER, APPLICATION OF

PURPOSE

To immobilize a suspected fracture of the finger and thus reduce pain and prevent further injury..

MATERIALS

1. Tongue depressor.
2. Roll of 1 inch adhesive tape.
3. Absorbent cotton.
4. Roll of 1 inch gauze bandage.

PROCEDURE

1. Pad the tongue depressor with absorbent cotton and secure padding with gauze roller bandage.
2. Apply padded splint to bottom of finger. Splint should extend from slightly beyond the tip of the finger onto the palm of the hand.

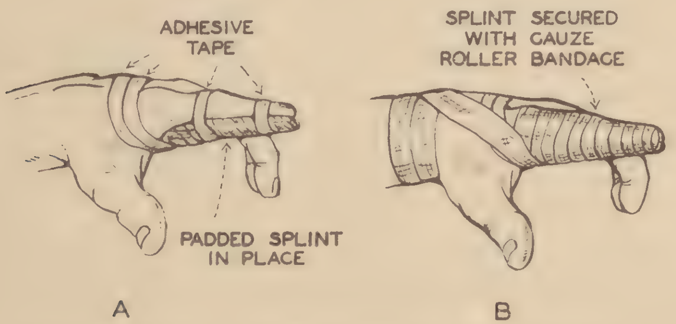


Figure 104. Tongue depressor applied as a splint to the finger.

3. Anchor the splint at the palm with two or more strips of adhesive tape extending over the back of the hand. Attach the splint to the injured finger by two or more narrow strips of adhesive tape.
4. Cover entire splinted area with 1 inch gauze roller bandage leaving the tip of the finger exposed. Anchor bandage at the wrist.

PRECAUTIONS

1. If an open wound is present on the finger, dress it independently and splint finger as described above.

2. Place hand and arm in a sling if discomfort of the patient is increased by movement.

3. Apply adhesive tape and bandage in such a way as to avoid constriction of the finger, hand, or wrist.

SPLINT; PILLOW, APPLICATION OF

PURPOSE

To immobilize an extremity in which a fracture is suspected in order to protect that extremity from further injury.

MATERIALS

1. One or more regular size bed pillows.

2. Several triangle bandages and sufficient amount of 3 inch gauze roller bandage.

3. Two, 6 inch wide, thin boards, sufficient to extend the length of the pillow.

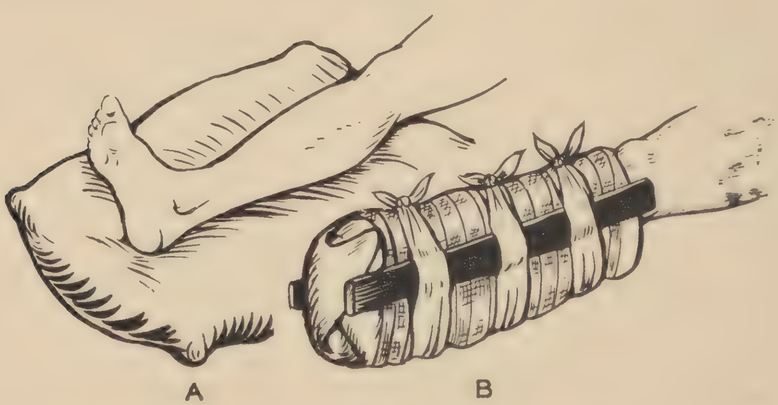


Figure 105. Pillow splint applied to the leg.

PROCEDURE

1. Place the pillow lengthwise under the injured extremity. Pillow should include the distal part of the extremity.

2. Envelop the injured extremity snugly in the pillow.

3. Secure pillow firmly with gauze roller bandage.

4. Place a board on each side of pillow and secure boards to the pillow with triangle bandages.

PRECAUTIONS

1. When splinting an extremity, always include the joints above and below the suspected fracture.

2. Any constricting or bulky clothing should be removed from the injured part before the splint is applied.

SPLINT; "T", APPLICATION OF

PURPOSE

To support and immobilize a suspected fracture of the clavicle and thus reduce pain and promote healing.

MATERIALS

1. Four to six basswood splints.
2. Absorbent cotton.
3. Four 3 inch rolls of gauze bandage.
4. Adhesive tape roll, 2 inches wide.

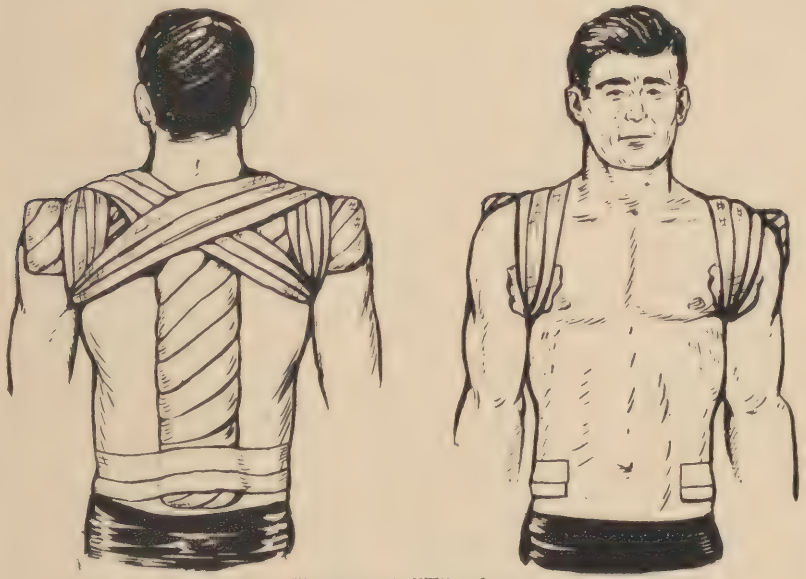


Figure 106. "T" splint.

PROCEDURE

1. Form a T with the basswood splints and secure them together with adhesive tape.

2. Pad all surfaces well with absorbent cotton and cover the padding with at least two thicknesses of gauze roller bandage.

3. Have assistant elevate and support the injured extremity at right

angles to the side of the body. Have the patient place the hand of the uninjured extremity on the top of his head. This position of the arms is maintained throughout the application of the T splint.

4. Place T splint in position, pad each axilla with gauze or gauze-covered cotton, and bandage splint securely in place employing a figure 8 bandaging technique.

5. Anchor lower end of T splint to the lower back with several 2 inch strips of adhesive tape.

PRECAUTIONS

1. During the application of the T splint, the patient's back should be straight and the shoulders should be braced backward, with assistance given to the injured side.

2. Do not apply securing bandage too tightly, but rather let the normal position of shoulders maintain tension. Observe the hands for cyanosis for several hours after the application of the splint.

3. If great discomfort is experienced while erect, confine patient to his bunk for a few days, lying on his back with the splint in place.

4. For additional comfort, a sling may be applied to support the arm of the injured side.

SPLINT; THOMAS, APPLICATION TO LEG

PURPOSE

To immobilize and apply traction to the leg when a fracture of the femur, tibia, or fibula is suspected.

MATERIALS

1. Thomas leg splint.
2. Three 3 inch gauze roller bandages.
3. Two triangle bandages.
4. Wooden peg or suitable substitute.

PROCEDURE

1. When applying the splint, two persons should participate: one to maintain the injured leg in position; the other to apply the splint.

2. Apply the traction hitch as illustrated.

3. Slip the ring of the splint over the foot with the short bar of the splint on the inside of the leg. Straighten the leg out slowly, while supporting it as much as possible.

4. The ring of the splint should pass up the leg and rest firmly against the buttock. Both side bars of the splint should be equidistant from the leg.

5. Secure the traction hitch to the lower end of the splint.

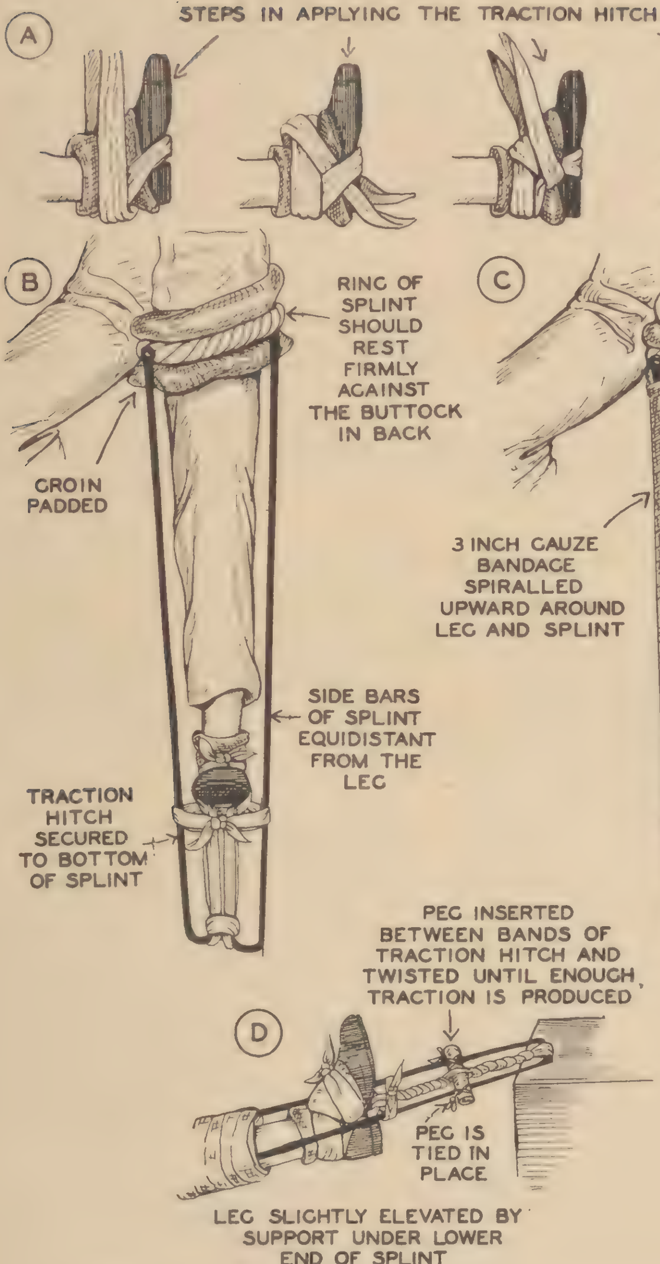


Figure 107. The Thomas splint applied to the lower extremity.

6. Secure the end of a 3 inch gauze roller bandage to the lower end of the splint near the ankle. Spiral bandage upward around entire leg and splint until the groin is reached.

7. Place a support under the lower end of the splint beyond the foot, elevating the leg slightly and supporting it completely.

8. Insert peg between the bands of traction hitch and twist until sufficient traction is produced and the leg is firmly held in position. Secure peg so that it does not untwist.

PRECAUTIONS

1. Always apply the traction hitch to the foot over the shoe.

2. If the ring of the splint exerts excessive pressure in the groin, padding should be inserted.

3. Never rest the splinted leg on the deck.

4. When applying the splint, make sure that the foot does not rotate outward. Maintain in direct line with the long axis of the leg.

STERILE EQUIPMENT AND SUPPLIES; RULES FOR HANDLING

1. To prepare for a sterile procedure, sterilize the necessary equipment by the proper method.

2. Do not allow sterile articles to come in contact with unsterile articles. Should a sterilized article touch an unsterilized article, it must be resterilized before being used.

3. Forceps used for handling sterile articles should be cleaned, sterilized by boiling, and placed in a sterile container of antiseptic solution. Do this daily. Avoid touching top or side of jar when removing forceps.

4. Before placing sterile equipment on a tray, cover the tray with two thicknesses of sterile towelling. Cover the sterilized equipment and tray with a sterile towel, until used, to prevent contamination.

5. When removing sterile articles from muslin covers, remove pin and unfold cover in such a way that contents are not touched. Remove contents of the package with sterile forceps and place on a sterile field.

6. Remove sterile vaseline gauze from container with sterile forceps. Cut strips to desired length with sterile scissors.

7. When removing sterile supplies from a covered sterile container, lift the lid straight up and use sterile forceps to remove contents. If it is necessary to put the lid down, lay it on the table with the rim turned up.

8. Keep pitchers containing sterile solutions covered with a sterile towel. Fasten in place with a rubber band or twine.

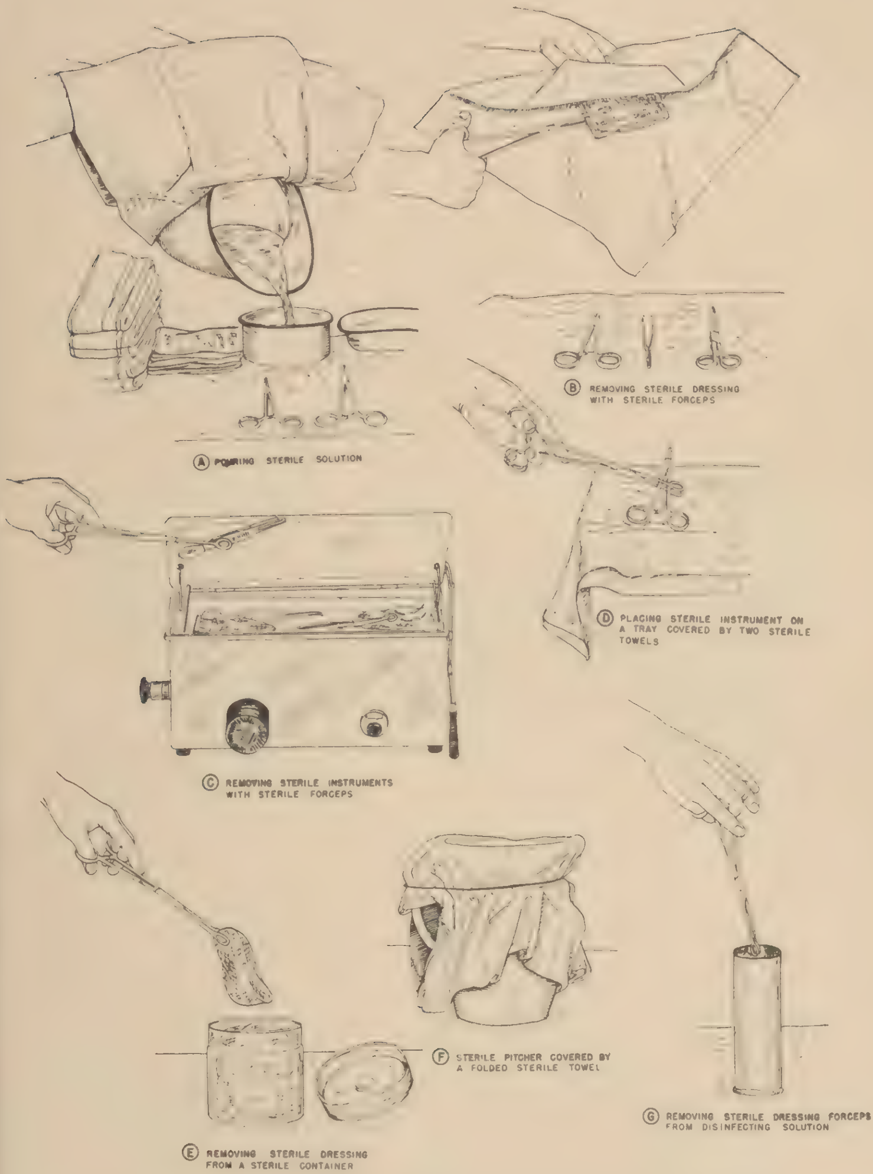


Figure 108. Some rules to be observed in handling sterile supplies.

9. When handling a sterile basin, support basin on sides and bottom. Do not grasp rim of basin with hands.

10. Before doing a surgical procedure: clean and trim the finger nails and scrub hands and forearms for ten minutes, using mild white soap and sterile brushes. Rinse with clear water. Rinse and soak hands and forearms in alcohol 70% for one minute. Dry with a sterile towel or put on sterile gloves using the wet glove technique.

STERILIZATION OF EQUIPMENT; BOILING

PURPOSE

To render sterile certain articles that are adaptable to this procedure.

MATERIALS WHICH MAY BE STERILIZED BY BOILING

1. Metalware (method of choice).
2. Glassware (method of choice).
3. Boilable suture materials in ampuls (method of choice).
4. Suture material on spools (method of choice).
5. Needles (method of choice).
6. Dull instruments (method of choice).
7. Rubber goods (method of choice).
8. Solutions for eye, wound, or bladder irrigations and wet dressings.

PROCEDURE

1. Scrupulously clean all articles before sterilization.

2. Completely immerse articles to be sterilized in actively boiling water. Weigh rubber gloves and tubes of suture material to keep them under the surface of the water.

3. Boil metalware, glassware, boilable suture material, suture needles, and dull instruments for twenty minutes.

4. Boil in *distilled water* for twenty minutes: intravenous and hypodermic needles, rubber tubing, glass adaptors, and drip indicators.

5. Boil rubber gloves for *ten minutes* and put on wet. Hands must be scrubbed with soap and water for ten minutes before putting on the gloves.

6. Boil rubber catheters for *ten minutes.*

7. Boil solutions in a loosely covered container for twenty minutes. Keep container covered after sterilization to prevent contamination. Roughly check solution after sterilization to determine extent of loss of water and consequent concentration of solution. Add sterile water as indicated.

8. Lift articles out of the boiling water with sterile forceps and place on double thickness of sterile towels.

9. Cover with a sterile towel until ready for use.

PRECAUTIONS

1. Make sure that the receptacle in which the articles are to be boiled is scrupulously clean.

2. All articles must be completely immersed in the boiling water during sterilization.

3. Rubber goods should not be boiled longer than directed. Prolonged exposure to heat deteriorates rubber.

4. Always use a double thickness of towelling to receive boiled articles to prevent moisture from seeping through to a contaminated surface.

5. Always cover sterilized articles with a sterile towel to keep them free from dust and prevent contamination.

6. Test gloves for holes by inflating with air or filling them with water before boiling.

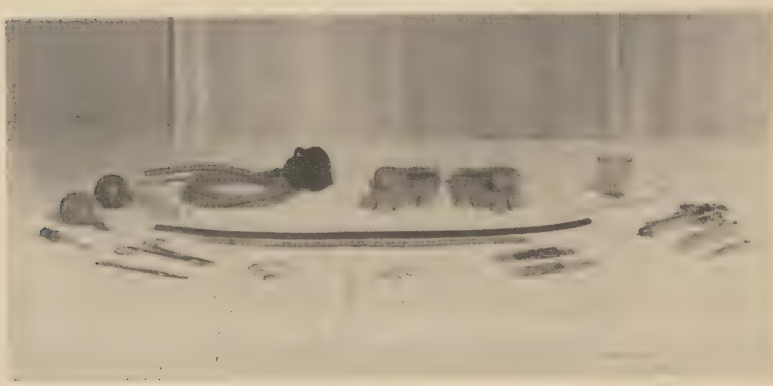
7. Test needles for obstructions and barbs before boiling.

STERILIZATION OF EQUIPMENT; CHEMICAL SOLUTIONS

PURPOSE

To render sterile certain articles to which this procedure is adaptable.

MATERIALS WHICH MAY BE STERILIZED BY CHEMICAL SOLUTIONS



1. Metalware.
2. Glassware.
3. Non-boilable suture material in ampuls (method of choice).
4. Boilable suture material in ampuls.
5. Needles.
6. Sharp instruments (method of choice).
7. Rubber goods.

CHEMICALS

1. Alcohol 70%.
2. Compound cresol solution 2.5%.
3. Commercially prepared solutions which may be made available from authoritative sources.

PROCEDURE

1. Thoroughly clean all equipment to be sterilized.
2. Completely immerse articles to be sterilized in the chemical solution and allow them to remain for twenty minutes.
3. Lift articles out of the chemical solution with sterile forceps and place on double thickness of sterile towels. If cresol compound or other irritating solutions have been used, rinse the article with alcohol 70% or sterile water before use.
4. Cover with a sterile towel until ready for use.

5. Rubber gloves, sterilized chemically, must be put on wet. Hands must be scrubbed with soap and water for ten minutes before putting on the gloves.

PRECAUTIONS

1. Be certain that the chemical solution is in contact with all surfaces of the articles to be sterilized. Completely cover the articles with the chemical solution and eliminate all air pockets. Weigh down rubber gloves, ampuls of suture material, and other materials that tend to float.

2. Test gloves for holes by inflating with air or filling them with water before immersing in the chemical solution.

3. Test needles for obstructions and barbs before immersing in the chemical solution.

4. Do not use bichloride of mercury for chemical solution sterilization.

5. Do not sterilize rubber tubing, glass tubing or dry goods by this method.

STERILIZATION OF EQUIPMENT; DRY HEAT

PURPOSE

This is an emergency procedure for sterilizing dry goods when presterilized materials or an autoclave are unavailable.

MATERIALS WHICH MAY BE STERILIZED BY DRY HEAT

1. Cotton.
2. Cotton tipped applicators.
3. Gauze.
4. Towels.
5. Sheets.
6. Surgical gowns.
7. Vaseline gauze.

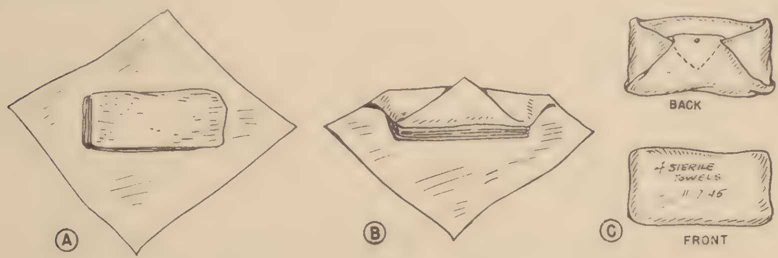


Figure 109. Method of wrapping supplies for sterilization.

PROCEDURE

1. Slightly dampen, as for ironing, the articles which are to be sterilized.

2. Wrap in double thickness muslin, towelling, or plain paper. Turn back a flap on the first fold of the wrapper so the package can be

opened without contaminating the contents. Pin securely, pushing the pin straight in so that only the head is exposed. Date and label the package.

3. Heat in a medium hot oven (320° F.—160° C.) for one hour.
4. Store in a dry place until used.

PRECAUTIONS

1. Articles to be sterilized must be scrupulously clean.
2. Make packages small. Dry heat will not penetrate to the center of a large package.
3. Check sterile supplies frequently so that a sufficient quantity will be available to meet any emergency.
4. Materials sterilized by this emergency method should not be used after two weeks without resterilization.

STRAPPING; ADHESIVE TAPE, APPLICATION AND REMOVAL OF

General Rules

PURPOSE

To limit motion and support injured parts of the body.

MATERIALS

1. Adhesive tape in appropriate widths and lengths.
2. Bandage scissors.
3. Razor.
4. Soap and water.
5. Alcohol.
6. Compound tincture of benzoin.
7. Gauze roller bandage.
8. Gauze compresses.
9. Flame from alcohol lamp or other source.
10. Carbon tetrachloride.
11. Talcum powder.

PROCEDURE

1. Make the patient as comfortable as possible and place him in such a position that the strapping may be applied without excessive bending or stretching on the part of the operator.
2. Remove sufficient clothing to adequately expose the part to be strapped.
3. Place the part to be strapped in such a position that all points are readily accessible, but at the same time, provide adequate support.

4. Shave hairy areas.

5. Wash area with soap and water and rinse with alcohol to remove all dirt, grease, and perspiration. Dry carefully.

6. Apply protective sterile dressings to any open wounds, if present.

7. Protect sensitive skin areas, such as the nipples, bony prominences in very thin individuals, or blisters, with thin gauze dressings.

8. Apply tincture of benzoin to the skin of the area that is to be strapped and allow to dry before application of adhesive tape. This substance acts as a protective coating and reduces skin sensitivity. It also makes the adhesive tape more adherent.

9. A sufficient number of adhesive strips of the proper width and length required for the procedure should be cut before commencing to strap the part.

10. Apply adhesive strapping with even, but firm, tension. Make sure the adhesive tape does not wrinkle. This wrinkling is usually produced by applying adhesive tape strips that are too wide. Several narrow strips of adhesive will serve the same purpose as a single wide one without danger of wrinkling.

11. Be sure that the skin is not pinched between successive layers of adhesive tape. This is usually caused by the application of strips of adhesive tape that are too narrow and by insufficient overlapping.

12. Never completely encircle a part with adhesive tape as this tends to interfere with circulation and increase swelling.

13. When practicable, temporarily cover adhesive strapping with roller bandage to obtain superior adherence.

14. Adhesive tape may be sterilized or made more tenacious by briefly exposing it to flame before application. This procedure is commonly followed prior to the application of "butterfly" adhesive tape dressings and before narrow strips of adhesive tape are applied directly over certain open wounds.

15. Adhesive tape should be removed gently and not ripped off. The gentle, relatively painless removal of adhesive tape is possible if carbon tetrachloride is applied to the edge of the strapping and as the strapping is removed the skin is pulled away from the adhesive tape with a gauze compress wet with carbon tetrachloride. Dressings that have been secured with adhesive tape are best removed by first cutting the adhesive tape along the edge of the dressing. Following the removal of adhesive tape, the skin should be cleaned with carbon tetrachloride, rinsed with alcohol, and dusted with talcum powder if adhesive tape is not to be reapplied.

PRECAUTIONS

1. Be sure that proper immobilization of the injured part has been achieved.

2. Be sure that the injured part is immobilized in the proper position.

3. Slight swelling adjacent to strapped areas is common after certain injuries. This may be reduced and partially prevented by elevation of the injured part. Excessive swelling requires restrapping.

4. Check the injured part for adequate circulation.

5. Attention should be paid to patient's complaints of itching, burning, or stinging sensations following strapping. If these symptoms occur, the strapping should be removed to ascertain the cause.

6. Keep strapped area dry for at least twenty four hours after adhesive tape has been applied.

STRAPPING; ADHESIVE TAPE, APPLICATION TO ANKLE

PURPOSE

To immobilize and support a sprained ankle.

MATERIALS

(See General Rules of Adhesive Strapping.)

PROCEDURE

1. Prepare one strip of adhesive tape 2 inches wide and long enough to extend from a point halfway up the inner surface of the leg, around the bottom of the foot, to a corresponding point on the outer surface of the leg. Prepare seven strips of adhesive tape 1 inch wide of similar length.

2. Prepare one strip of adhesive tape, 2 inches wide and long enough to extend from the base of the little toe, around the back of the ankle, to the head of the first metacarpal joint. Prepare seven strips of adhesive tape, 1 inch wide, of similar length.

3. Prepare the skin.

4. Place the foot in the correct position and have patient maintain this position by pulling on both ends of a 2 inch wide gauze bandage applied as a stirrup around the ball of the foot. Foot should be at right angles to the leg. If the injured ligaments are on the inside of the ankle, the foot should be turned slightly inward (inverted). If the injured ligaments are on the outside of the ankle (most common injury), the foot should be turned slightly outward (everted). This slight inversion or eversion decreases strain on the injured ligaments.

5. Apply center of long, 2 inch adhesive strip under the heel and apply to both sides of the leg simultaneously in such a way that the adhesive tape passes directly over the bony prominences of the ankle.

6. Apply the center of the short, 2 inch adhesive strip to the back of the heel and bring the ends around to both sides of the instep so that the upper edge of the adhesive strip is just beneath the bony prominences of the ankle.

7. Alternately apply long and short strips of 1 inch adhesive tape.

8. The first long strips should be applied well back on the calf of the leg and each succeeding long strip should overlap the preceding one by ½ its width. Following the application of the last of these strips, only a small portion of the anterior surface of the leg should remain uncovered by adhesive tape.

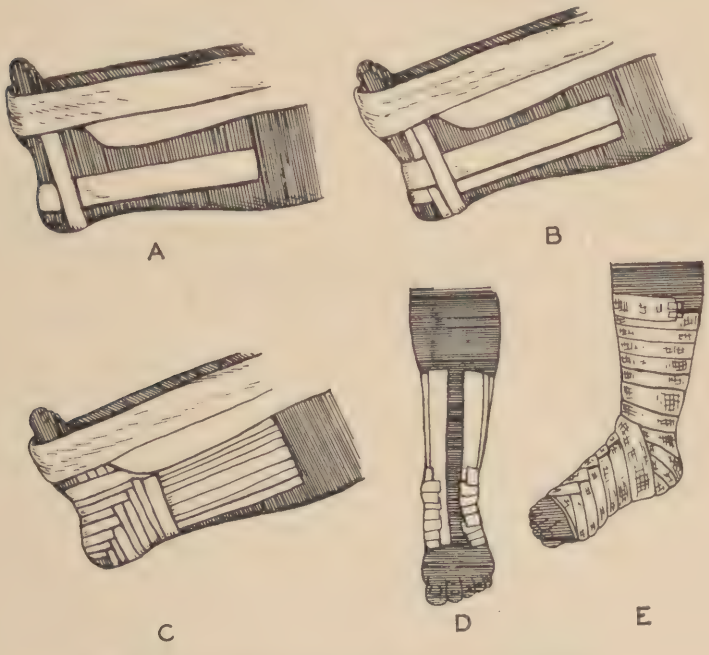


Figure 110. Adhesive tape strapping of the ankle.

9. The short, 1 inch strips of adhesive tape should be applied in an overlapping fashion from the bottom up until they extend well above the ankle. These strips should be trimmed so that they do not extend completely around the foot.

10. Cover the strapped area with gauze roller bandage.

PRECAUTION

Be sure the foot is maintained in the propre position throughout the entire procedure.

STRAPPING; ADHESIVE TAPE, APPLICATION TO CHEST

PURPOSE

To partially immobilize the chest in the presence of a suspected rib fracture.

MATERIALS

(See General Rules of Adhesive Tape Strapping)

PROCEDURE

1. Measure and cut eight strips of 3 inch adhesive tape. These strips should be long enough to extend from 3 inches beyond the midline of the back (spinal column), around the affected side to 3 inches beyond the midline of the front of the body.

2. Prepare the skin.

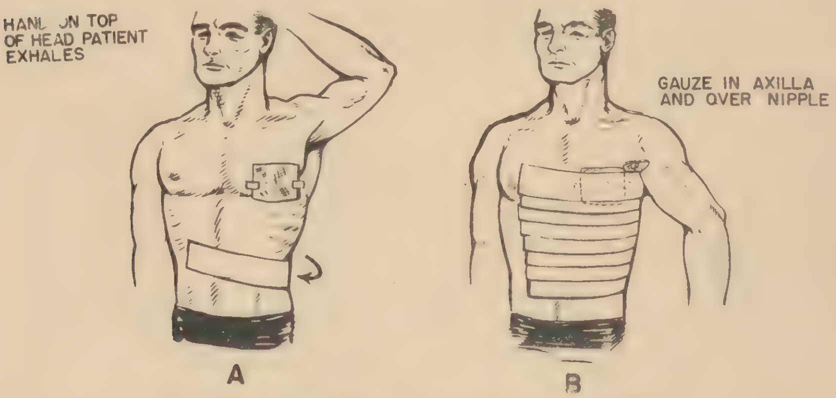


Figure 111. Adhesive tape strapping of the chest.

3. Whenever possible, have the patient stand with the hand of the arm on the affected side placed on the top of the head. Cover nipple of the affected side with gauze dressing.

4. Grasp the first strip of tape with a hand on each end of the tape.

5. Instruct patient to exhale and withhold breath as long as possible. Firmly apply the tape to the skin, starting at the lower border of the ribs 3 inches past the midline of the back, around the affected side, and to a point 3 inches beyond the anterior midline of the body. Apply adhesive strips during the periods of exhalation.

6. Repeat with remaining strips of adhesive tape, overlapping one half the width of the previous strip, and working upward.

PRECAUTIONS

1. Be sure that patient exhales and withholds breath.
2. Adhesive tape should be applied firmly, evenly, and with as much tension as possible.

STRAPPING; ADHESIVE TAPE, APPLICATION TO KNEE

PURPOSE

To support and immobilize the knee joint.

MATERIALS

(See General Rules of Adhesive Tape Strapping)

PROCEDURE

1. Cut and measure 12 strips of 1 inch adhesive tape. These strips should be long enough to almost completely encircle the leg above, at, and below the knee joint, leaving a 1 inch space of bare skin at the posterior midline of the knee.
2. Prepare the skin.
3. Have patient completely extend the knee. Grasp the first strip of adhesive tape with one hand on either end of the tape.
4. Apply center of the first strip of tape directly over the anterior middle portion of the knee and bring the ends around the sides of the knee.
5. Apply the second strip, working upward, so that it overlaps the previous strip by one half its width. Repeat with the next five strips.
6. Apply the eighth strip of adhesive tape over the exposed portion of the first strip. Tension is applied simultaneously with both hands but on a level plane instead of a downward pull.
7. Repeat with the remaining adhesive tape strips working downward.
8. Cover the strapping with a gauze roller bandage.

PRECAUTIONS

At no point, should the strips of adhesive tape completely encircle the part. A bare space, devoid of adhesive tape, about 1 inch wide should extend up the posterior midline.

STRAPPING; ADHESIVE TAPE, APPLICATION TO LOWER BACK

PURPOSE

To support and partially immobilize the lower back.

MATERIALS

(See General Rules of Adhesive Tape Strapping)

PROCEDURE

1. Measure and cut eight strips of 3 inch adhesive tape. These strips should be long enough to extend around the body to 3 inches on either side of the anterior midline.

2. Prepare the patient's skin.

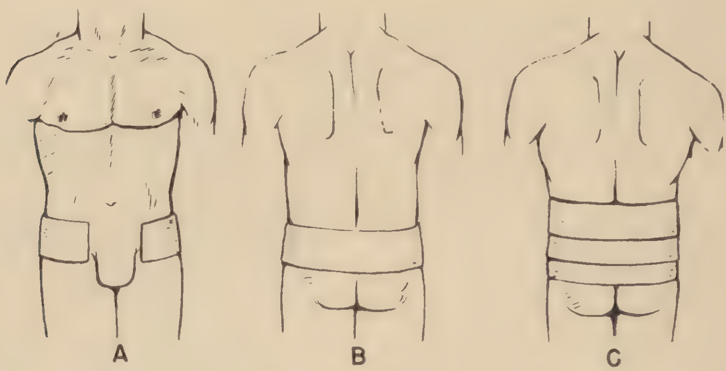


Figure 112. Adhesive tape strapping of the lower back.

3. Whenever possible, have patient stand with body bent forward slightly from the waist with hands placed against bulkhead or on back of chair for support.

4. Grasp the first strip of adhesive tape with one hand on either end of the tape.

5. Begin the strapping by applying the first strip anterior to the left hip about 3 inches from the mid-line. With a firm even pull, this strip is carried around the body just above the gluteal fold to a corresponding point on the right side of the abdomen.

6. Repeat with the remaining strips of adhesive tape, overlapping one half the width of the previous strip and working upward.

PRECAUTIONS

1. Avoid placing tape over the pubic hair. If necessary, a gauze dressing can be placed over this area, preliminary to strapping.

2. Anterior midline of the body should be free of adhesive tape.

SUPPORT; SCROTAL, CONSTRUCTION AND APPLICATION OF

PURPOSE

To support and immobilize the scrotum.

MATERIALS

1. Four inch wide strip of adhesive tape of sufficient length to reach from the lateral midpoint of the right thigh to lateral midpoint of the left thigh. This adhesive strip should be backed with another adhesive strip so that only a 4 or 5 inch adhesive surface remains on each end. A semicircle, 1½ inches in radius, should be cut in the midpoint of one of the edges of the strip.
2. Large gauze compress, 4 inches long by 1 inch wide.
3. Four adhesive strips, 4 inches long by 1 inch wide.
4. Razor.
5. Tincture of benzoin.
6. Cotton applicators.

PROCEDURE

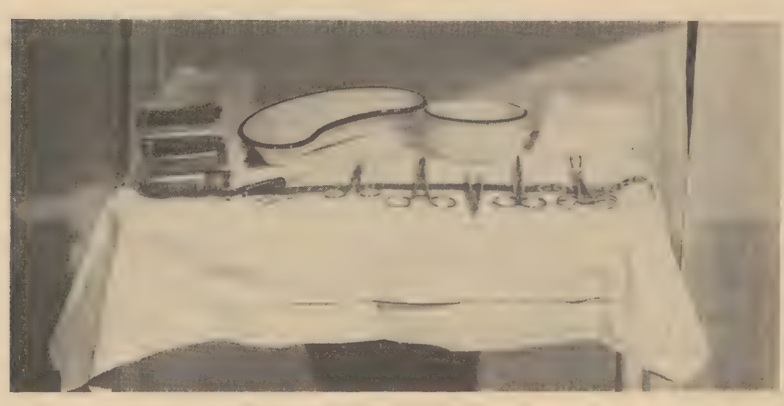
1. Assemble necessary materials and carry to patient's bedside.
2. Explain the procedure to the patient to gain his confidence and cooperation.
3. Shave patient's thighs, dry, and apply tincture of benzoin with the cotton applicators to the shaven area.
4. Elevate patient's scrotum and instruct patient to bring thighs together.
5. Apply adhesive strip to side of one thigh at its midpoint, bring across the top of both approximated thighs, and secure by bringing it down to the midpoint of the other thigh. Cut-out semicircle should be fitted to encompass the root of the scrotum.
6. If the patient is restless, or if the scrotum needs to be further immobilized, place the large gauze compress over the top of the scrotum and secure to the support with adhesive tape.

SUTURING

PURPOSE

To reduce the gap in a wound by sewing and thus bring about more rapid healing.

MATERIALS



1. Tray (wood, metal, plastic).
2. Sponge basin containing normal saline solution.
3. Emesis basin.
4. Sterile 4 x 4 compresses.
5. Six sterile towels.
6. Four towel clips.
7. Needle holder.
8. Mouse tooth thumb forceps.
9. Suture scissors.
10. Straight Kelly hemostat.
11. Two curved, cutting edge needles.
12. Non-absorbent suture material.

PROCEDURE

1. Assemble equipment and sterilize.
2. Place sterile articles on a tray which has been covered with two sterile towels.
3. Scrub hands and forearms for ten minutes.
4. Clean area around wound with soap and water. Drape area with four sterile towels, secured with towel clips.
5. Cut suture material into 12 inch lengths and thread both needles.
6. Grasp needle with needle holder near the middle (nearer the suture than the point).

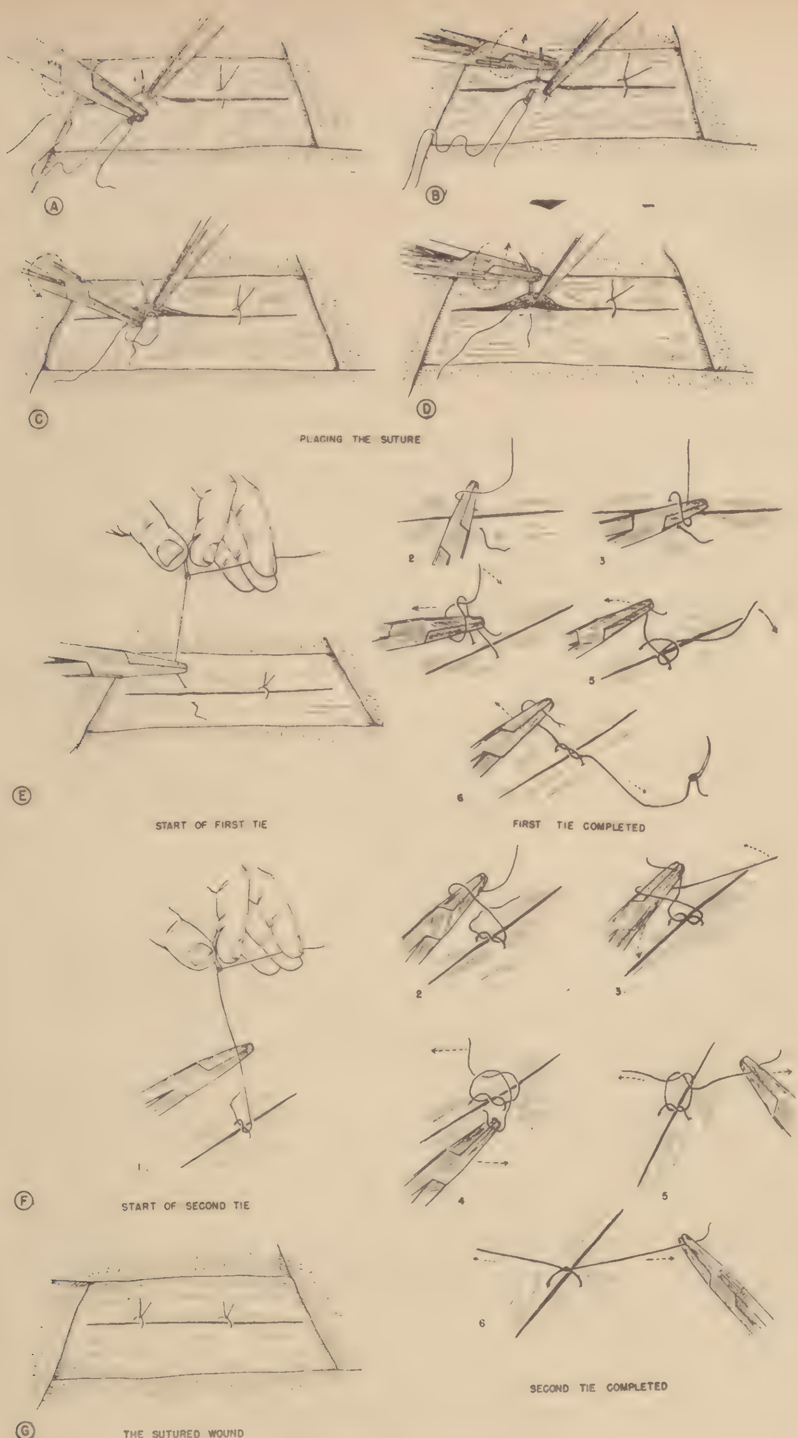


Figure 113. Suturing.

7. Using tissue forceps, lift up skin edge at one end of wound.

8. Push needle through skin from surface to underside about a quarter of an inch from wound margin. Use a twisting motion of the wrist. Pull all but one inch of the suture material through the skin.

9. Grasp needle with needle holder as before and pick up opposite skin edge with forceps.

10. Push needle through from under side to surface about a quarter of an inch from wound margin. Pull the suture material through the skin.

11. Tie a square knot in the suture using the instrument technique. *To tie the first knot:* Grasp needle with one hand and needle holder with the other. *Lay needle holder on top of suture* near the needle and wrap one loop of suture around the tip of it. Grasp free end of suture on opposite side of wound with needle holder and pull it through the loop. Draw knot down to wound. Allow 1/8 inch of space to remain between skin edges to allow for swelling.

To tie the second knot: Grasp needle and needle holder as before and *place needle holder under* suture near needle. Wrap a loop of suture around tip of needle holder in *reverse* direction. Grasp free end of suture with needle holder and pull through loop as before. Make knot secure.

12. Cut ends of suture 1/2 inch from the knot.

13. Space stitches about 1 inch apart. In most wounds less than 2 inches long, one suture is enough.

14. Apply a dry sterile dressing and fasten in place with adhesive or bandage.

15. Record procedure on patient's chart.

16. Clean and store equipment.

PRECAUTIONS

1. Maintain sterile technique.

2. Avoid trauma to wound edges. Do not grasp them too tightly with forceps.

3. Use a twisting motion of the wrist when inserting the needle through the skin edges to avoid breaking the needle.

4. To avoid puckering of a wound, make both needle punctures of each stitch directly opposite each other.

5. Always leave a space between the wound edges to allow for swelling. If wound edges overlap or turn down into the wound, healing will not take place.

6. Remove sutures on the sixth day. To remove: Paint the suture line with a skin disinfectant, and cut each stitch on one side, as close to the skin as possible. Grasp long end and pull. Short end will be

drawn under and out. Avoid carrying contamination from exterior to underneath the skin. After removing all sutures, paint area with a disinfectant and apply a dry, sterile dressing. Secure dressing with adhesive or bandage.

7. If signs of infection appear around a stitch, paint the suture line with a skin disinfectant, remove infected stitch, and apply moist heat.

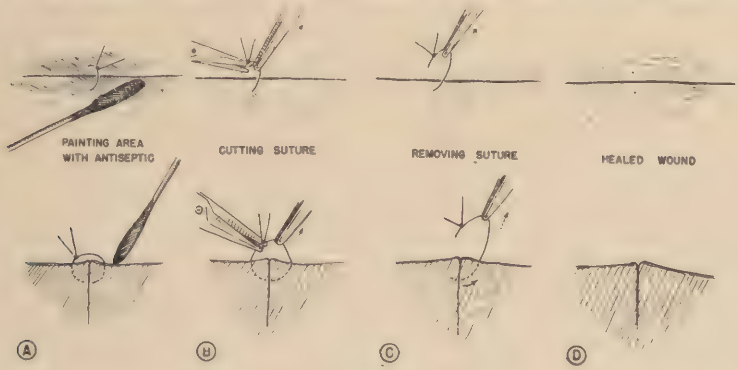


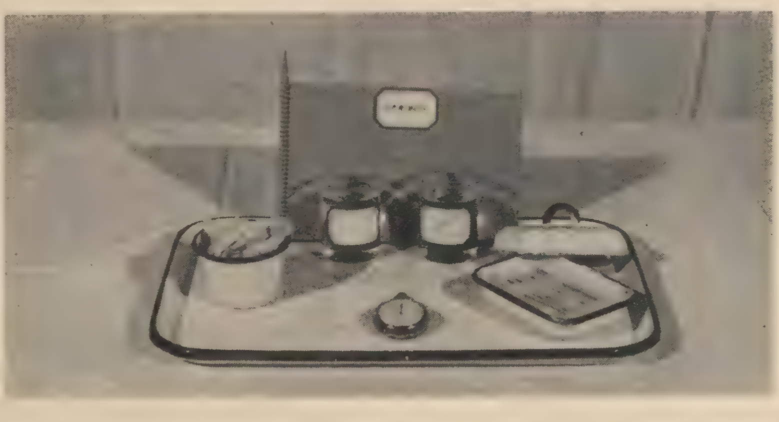
Figure 114. Removal of sutures.

TEMPERATURE, PULSE AND RESPIRATION

PURPOSE

To obtain and record an accurate reading of the patient's temperature, heart rate, and respiratory rate.

MATERIALS



1. Tray.
2. Covered metal soap dish (5″ x 3¾″ x 1¼″) containing sufficient disinfectant (alcohol 70%) to completely cover the thermometers.

3. Thermometers (6).
4. Gauze or paper wipes.
5. Container with soap solution.
6. Container with water.
7. Watch with second hand.
8. Book and pencil.

PROCEDURE

Oral Temperature

1. Have the patient sit quietly or lie down.

2. Wipe the disinfectant from the thermometer.

3. Shake down the thermometer until it reads about 95° F. (35° C.).

4. Place the thermometer under the tongue and leave in place for three minutes. The patient must keep lips tightly closed during this time.

6. Remove the thermometer, wipe off mucus and saliva and obtain reading.

7. Wash the thermometer in cool soapy water, rinse, and return to the disinfectant solution; allow to remain at least three minutes.

8. Record the findings.

9. If a temperature reading is required for several persons, six thermometers will be a convenient number with which to work. Obtain the temperature, pulse, and respiration readings in groups of three. After the temperature readings are obtained, the thermometers should be cleaned and placed in the disinfectant solution. This procedure will allow for adequate disinfection of the thermometers.

Rectal Temperature

Take a rectal temperature when the patient is unable to cooperate with the oral method.

1. Have the patient lie on his side or, if this is impractical, on his back.

2. Shake down the thermometer to 95° F. (35° C.).

3. Insert a lubricated rectal thermometer approximately one inch into the rectum.

4. Hold the thermometer in place for three minutes.

5. Count the pulse and respirations.

6. Remove, wipe and read the thermometer.

7. Clean the thermometer in cool soapy water, rinse and disinfect.

8. Rectal thermometers should not be placed in the same container with oral thermometers.

9. Record the findings. Indicate temperature was obtained by rectum; example: 99.6° F. (R).

PROCEDURES

Axillary Temperature

This procedure should be used in those rare instances when it is impossible to obtain either a rectal or an oral temperature.

1. Use either a clean rectal or oral thermometer.

2. Place the thermometer in the axilla and hold in place for ten minutes (arm held tightly against body).

3. Count the pulse and respirations.

4. Remove, read, clean and disinfect thermometer.

5. Record the findings. Indicate the temperature was obtained by axilla; example: 97.6° F. (ax.) |

The Pulse

1. The pulse reading is ordinarily obtained at the same time as the temperature.

2. The pulse is usually felt at the wrist, but may be counted any place where an artery is close to the skin.

3. Count the pulse for one half minute and multiply by two in order to obtain the rate per minute. If there is any question of the accuracy of the first count, repeat.

4. Record the rate and in addition, record any unusual features, such as irregularities and weakness.

Respiration

1. Count the respiration rate for one half minute, by observing the rise and fall of the chest or abdomen, and multiply by two in order to obtain the rate per minute.

2. If the respirations are irregular, less than 10 or more than 50 per minute, the count should be made for one minute.

PRECAUTIONS

1. Be sure the thermometer has been disinfected before use.

2. Be sure the thermometer has been shaken down to the correct temperature, 95° F. (35° C.).

3. Do not insert a thermometer into the mouth of an uncooperative patient.

4. Do not take an oral temperature of a person within ten minutes after he drinks hot or cold fluids.

5. Always hold the thermometer while taking a rectal temperature.

6. Do not mix thermometers used for rectal temperatures with those used for oral temperatures.

7. Take temperature, pulse, and respiration only when the patient is at physical and, if possible, emotional rest.

8. Count the pulse with the finger tip, not the thumb.

THROAT; IRRIGATION OF

PURPOSE

1. To relieve inflammation and congestion.
2. To clean all parts of the throat.

MATERIALS

1. Irrigating can with three feet of rubber tubing and stopcock.
2. Irrigating tip (glass drinking tube or tip of medicine dropper or rubber catheter).
3. Large wash basin.
4. 1000 cc. (1 quart) warmed solution: salt solution 1%, sodium bicarbonate solution 4%, alkaline aromatic solution, 8 tablets per quart.
5. Small rubber sheet.
6. Face towel.
7. Safety pin.

PROCEDURE

1. Wash hands.
2. Place patient in position, sitting up in chair or propped up in bed.
3. Protect chest with small rubber sheet and face towel. Secure in back of neck with safety pin.
4. Have patient hold large wash basin under chin to catch return flow.
5. Fill irrigating can with 1000 cc. (1 quart) of warmed solution, and suspend above the level of the patient's head.
6. Insert irrigating tip into mouth and rotate so that steady stream of solution reaches all parts of throat.
7. Interrupt irrigation at intervals to allow the patient to breathe and clear his throat.

PRECAUTION

Do not injure throat with irrigating tip or too hot a solution.

TOURNIQUET; RUBBER TUBING, APPLICATION OF

PURPOSE

To control hemorrhage in an open wound of an extremity.

MATERIALS

Rubber tubing, at least $\frac{1}{4}$ inch thick and 2 feet long.

PROCEDURE

(For Arm or Thigh)

1. Make two complete turns around the thigh or arm, stretching the tubing as the turns are made.
2. Secure tourniquet in place with a square knot or hemostat after completion of the two turns.

PRECAUTIONS

1. Avoid pinching or otherwise damaging the skin, while stretching the rubber tubing, by holding it away from the skin.
2. Observe precautions listed below: Triangle Bandage Tourniquet.

TOURNIQUET; TRIANGLE BANDAGE, APPLICATION OF

PURPOSE

To control hemorrhage from an open wound of an extremity.

MATERIALS

1. Triangle bandage folded to 4 inch width.
2. Wooden peg, 4 inches long, $\frac{1}{2}$ inch thick or suitable substitute.
3. Roll of gauze bandage or thick gauze pad.

PROCEDURE

(For the Arm or Thigh)

1. Place the center of the folded triangle bandage on the outside of the arm or thigh midway between shoulder and elbow or knee and hip.
2. Pass both ends around and under the arm or thigh, and back to original position. Tie half a square knot and take up slack in bandage.
3. Tie a complete square knot over the half square knot.
4. Insert roll of gauze bandage or thick gauze pad under triangle bandage on inner surface of arm or thigh, approximately over site of brachial artery (arm) or femoral artery (thigh).

5. Insert wooden peg between knots in bandage on outer surface of arm or thigh and twist peg until bleeding stops.

6. Tie peg in place with ends of triangle bandage.

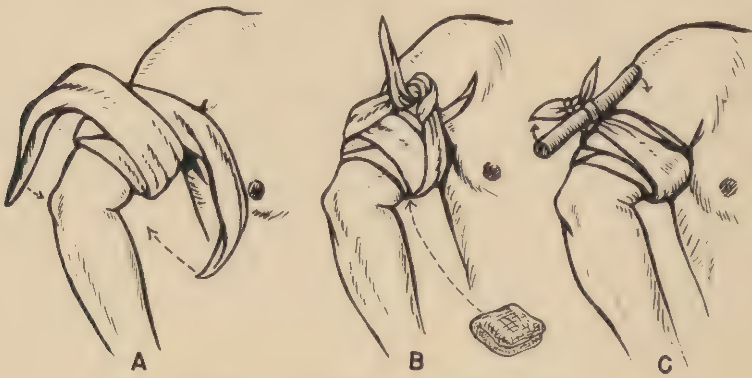


Figure 115. Tourniquet applied to arm.

PRECAUTIONS

1. Never use narrow cutting material, such as wire or thin line, to construct a tourniquet.

2. Never leave the tourniquet in place more than thirty minutes; then cautiously release it, while controlling hemorrhage by direct pressure at wound site, to ascertain hemorrhage control and to flood the vascular bed to prevent the development of gangrene.

3. Do not apply the tourniquet too loosely as this only increases venous bleeding; do not apply the tourniquet too tightly as damage to tissues and nerves may result.

4. Never cover tourniquet with clothing or dressings. Mark time of application clearly on patient's forehead or on a tag attached to his clothing.

TRANSPORTATION OF PATIENTS

General Principles

PURPOSE

To remove a patient from a dangerous environment or to move a patient to a location where more adequate treatment is available, in as safe a manner as is possible.

MATERIALS

1. Stokes litter.
2. Army litter.

3. Blankets, items of clothing, sheets, large pieces of canvas, etc.
4. Poles, oars, etc.
5. Properly trained attendants.

PROCEDURE

1. Carries should be used to remove patients from a dangerous environment, such as a fire, when they are the only means of transportation immediately available, when the patient needs only slight support, or is being moved only for a slight distance.

2. Never aggravate the patient's condition by clumsy or rough handling.

3. When employing a litter, carry the litter to the patient, not the patient to the litter.

4. Sources of bleeding must be controlled, fractures and dislocations must be immobilized, wounds requiring temporary dressings must be dressed, pain should be controlled, if required, and shock must be prevented and treatment instituted, if necessary, before the patient is moved.

5. Patient should be secured to the litter in such a way that there is no danger of his falling out and so that parts of his body do not project or dangle from the litter.

6. Patient should be adequately protected against exposure by a sufficient number of blankets. This may be accomplished by folding two blankets, lengthwise, in thirds. The blankets are then placed on the litter in a manner that permits the top layer to be folded outward. The patient is placed on the litter and the upper layer of each blanket is folded over him and tucked under his body.

7. Certain injuries require special handling to make certain that splints and dressings do not come loose and that further injury is not produced. Patients with suspected fractures of the vertebrae should be carried in such a way that the spine is in a position of extension. This may be accomplished by inserting a pillow or rolled up blanket under the back at the site of suspected injury.

The patient should also be carried in such a way that harmful pressure is not applied to the injured area.

8. An adequate number of attendants should be available. Four men are ordinarily required to carry a litter and an additional attendant should be available to attend to the needs of the patient while he is being carried.

TRANSPORTATION OF PATIENTS; CARRIES

PURPOSE

To remove an injured person from a dangerous area.

PROCEDURE

Carries vary from the mere provision of support for the injured person to the actual carrying of the patient by one or more people. The provision of support to an injured or sick person may be all that is required and, under this condition, this method of transportation is appropriate. It is also proper to carry a patient for a short distance provided his condition does not make this procedure inadvisable. With the exception of these two conditions, carries should not be used unless they are the only means of transportation that are available and the patient is in an environment from which he must be immediately removed.

Figure 116. Methods of carrying patients.

TRANSPORTATION OF PATIENTS; IMPROVISED LITTER

MATERIALS

1. Blankets or other strong material of similar size.
2. Two oars or poles about 7 feet long.

PROCEDURE

1. Fold the blanket in half, lengthwise, around one of the oars.
2. Place the other oar on the folded blanket and fold the free ends over the second oar so that the free ends of the blanket almost reach back to the first oar.

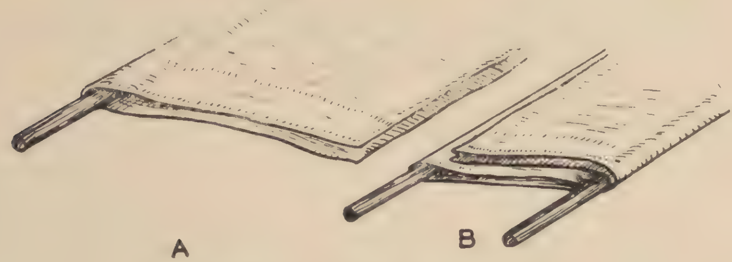


Figure 117. Improvised litter.

3. The blanket may be pinned in several places for safety; however, the weight of the patient on the free ends of the blanket is usually adequate to hold it in place.
4. If the blanket is not pinned in place, extreme care must be exercised when carrying a patient on this litter. If the patient moves and shifts his weight, the litter is apt to come apart.

TRANSPORTATION OF PATIENTS; STOKES LITTER

MATERIALS

1. Stokes litter.
2. Three blankets.
3. Five retaining straps.

PROCEDURE

1. Cover the stretcher with two blankets placed lengthwise so that one blanket extends down each leg. Fold the third blanket in half and place in upper portion of the litter as a protection for the head and shoulders.

2. Place patient on his back in litter and make him as comfortable as possible.

3. Place a strap under his shoulders and bring the two ends under his arms, up over the shoulders and secure to the upper end of the litter. The ends of the straps should be placed widely enough to prevent rubbing of the patient's face and ears.

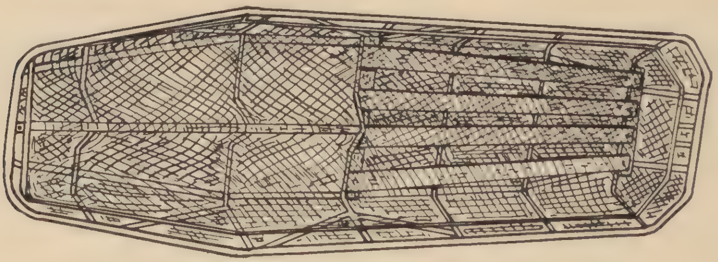


Figure 118. Stokes litter.

4. Secure patient's feet to litter arranging a strap around his feet in a figure of 8. It is necessary to secure the strap to the sides of the litter in such a manner as to prevent the straps sliding up and down with shifts of the patient's weight.

5. Cover the patient with blankets and secure him in place with the remaining three straps. These straps should be placed over the chest, hips, and knees.

PRECAUTIONS

1. It is unnecessary to secure the shoulders and feet of the patient unless the litter will be held in a vertical manner during transportation.
2. Be sure the armpits and feet are adequately padded.
3. Even though the patient is securely fastened in the litter, the litter should be carried in as level a manner as possible.

ULCER, DECUBITUS; PREVENTION OF

PURPOSE

To employ measures to prevent the local destruction of tissues due to prolonged pressure and the resulting inadequate circulation.

MATERIALS

1. Padding: rubber air rings, pillows, and cotton rings and pads.
2. Alcohol, 70%.

PROCEDURE

1. Change the patient's position every two hours to relieve pressure on bony prominences.

2. Examine the skin around bandages, casts, splints, traction, and other appliances, to note the adequacy of circulation.

3. Maintain the skin overlying bony prominences scrupulously clean and dry. Massage these areas with 70% alcohol at frequent intervals to stimulate circulation.

4. Keep bedding clean, dry, and unwrinkled.

5. Distribute pressure over wide areas by the judicious use of pads and pillows. Pressure can be relieved completely from certain bony prominences by the use of air rings.

ULCER, DECUBITUS; TREATMENT OF

PURPOSE

To prevent secondary infection and promote rapid healing.

MATERIALS

1. Alcohol, 70%.
2. Compound tincture of benzoin.
3. Sunlight.
4. Light cradle.
5. Sterile cotton applicators.
6. Padding: rubber air rings, pillows, and cotton rings and pads.

PROCEDURE

1. Wash surrounding area thoroughly at least twice a day with warm water and soap, and massage with 70% alcohol.

2. Clean ulcer well and remove all sloughing material with sterile applicators dampened with solution made of equal parts of hydrogen peroxide and sterile water.

3. Dry with sterile cotton applicators.

4. Apply compound tincture of benzoin to the denuded area.

5. With the use of pillows and air cushions, keep weight off ulcerated areas until healed.

6. Expose ulcerated areas to air and sunlight if possible.

7. Apply dry heat.

8. Apply moist heat in the form of hot boric solution packs to relieve pain and inflammation if infection is present.

PRECAUTION

Be careful not to burn the skin when applying heat.

VACCINATION; SMALLPOX

DEFINITION

Smallpox vaccination is an intradermal injection of a small amount of living cowpox virus.

PURPOSE

To introduce cowpox virus (smallpox vaccine) into the body so that the body will be stimulated to produce immunity against smallpox.

MATERIALS

1. Potent smallpox vaccine (capillary tubes).
2. Sterile needle.
3. Rubber bulb.
4. Acetone or alcohol sponge.

PROCEDURE

1. Put one end of the capillary tube containing the vaccine into the rubber bulb. Break off the tip of the tube inside the rubber bulb.

2. Wipe the unbroken end of the capillary tube with the acetone or alcohol sponge. Place the disinfected capillary tube on a piece of sterile gauze.

3. Disinfect the skin of the upper arm with acetone or alcohol sponge. Allow to dry.

4. Break off the other end of capillary tube using a piece of sterile gauze.

5. Cover the hole in the rubber bulb with one finger and, by squeezing the bulb, force the vaccine from the capillary tube onto the skin at the site to be vaccinated.

6. Remove sterile needle from its container without contaminating the point.

7. Stretch the skin taut and, with the needle held almost parallel to the skin surface, make 30 impressions through the drop of vaccine. These impressions must be made in an area not more than 1/8 inch in diameter. If the needle is held almost parallel to the surface, its point is not pushed into the skin, but penetrates because of the skin's tendency to fold over the end of the needle. In this way, the vaccine is always placed at the proper depth.

8. Allow the vaccine to dry before dismissing the patient.

9. Examine the vaccinated site in forty-eight hours. A reaction at this time indicates a successful vaccination and immunity. If no reaction is visible, question the patient closely to find out whether or not itching, burning or redness had been present and has now disappeared. If this

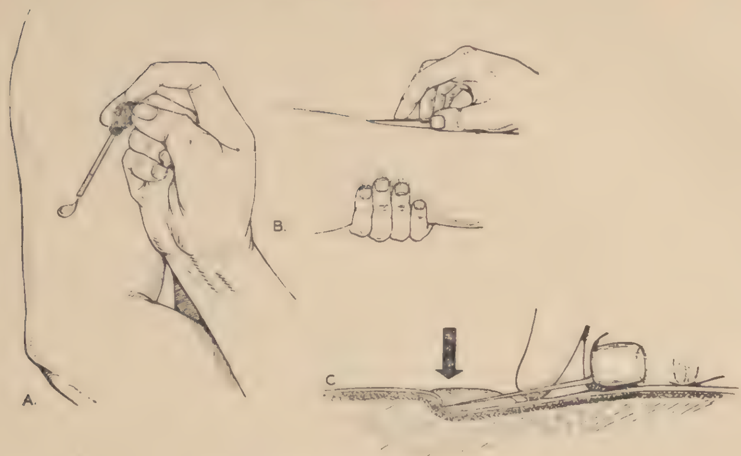


Figure 119. Smallpox vaccination.

has happened, it is also an indication of immunity and a successful vaccination.

If there is no reaction or a history of reaction, have the patient return on the fifth day. A reaction at this time is indicative of a successful vaccination ("take") but no previous immunity.

If no reaction has occurred within five days, the procedure was unsuccessful and must be repeated.

PRECAUTIONS

1. Use only vaccine that has been properly stored and is not out-dated.
2. Use sterile technique.
3. Be sure that acetone or alcohol solution has evaporated from the skin before applying vaccine.
4. Do not scratch or jab skin with needle.
5. Do not cover site of vaccination with a dressing.

WOUND CLOSURE; CONSTRUCTION AND APPLICATION OF "BUTTERFLY" ADHESIVE STRIPS

PURPOSE

To approximate edges of minor wounds and thus encourage healing.

MATERIALS

1. Roll of 1 inch adhesive tape.
2. Match or alcohol lamp.
3. Bandage scissors.
4. Sterile thumb forceps.

PROCEDURE

1. Cut strip of adhesive at least 3 inches long.

2. Near the center of the adhesive strip, cut away adhesive on each side so that a center bridge 1/8 inch wide and 1/2 inch long remains.

3. Sterilize center bridge with flame.

4. Apply one end of prepared butterfly adhesive strip to the skin surface on one side of the wound.

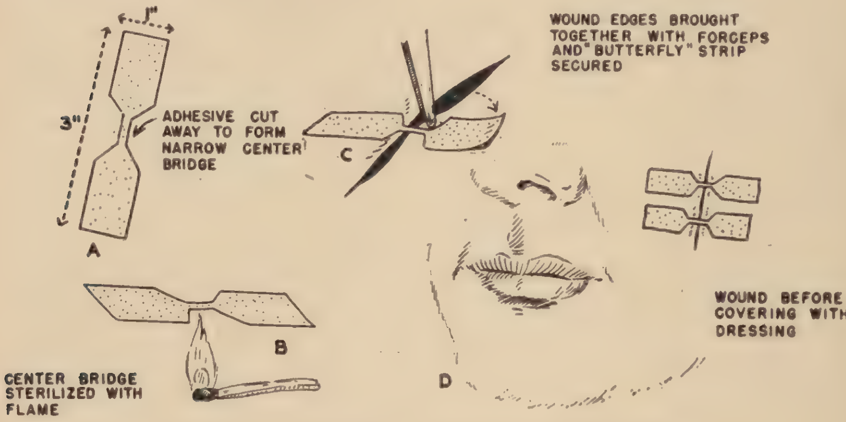


Figure 120. Adhesive tape for closure of wounds.

5. Approximate the edges of the wound with the sterile thumb forceps and secure the other end of the butterfly adhesive strip beyond other wound edge. The center narrow bridge of the butterfly adhesive strip should fall directly over the approximated wound edges.

6. Apply sufficient number of butterfly adhesive strips to obtain adequate wound closure. Then cover the wound with a sterile dressing.

PRECAUTIONS

1. The width of the center bridge of the butterfly adhesive strip should be as narrow as possible, never to exceed 1/8 inch. This allows for adequate wound drainage, if necessary, and also minimizes the danger of infection.

2. The butterfly adhesive strip is generally left in place from five to seven days. It is then removed by pulling both ends loose toward the wound, thus reducing the possibility of disrupting incompletely healed tissue.

3. The two ends of the butterfly adhesive strip should be of sufficient size to provide adequate anchorage. Body perspiration, hairy areas, and motion of the part are all factors that must be considered.

Chapter VII

LABORATORY PROCEDURES

MICROSCOPIC STUDIES

PURPOSE

To use the microscope for study of specimens.

MATERIAL

1. Microscope.
2. Lamp.
3. Slides.
4. Cover slips.
5. Distilled water.
6. Suitable specimens or preparations for study.
7. Immersion oil.
8. Lens paper.
9. Xylol.

PROCEDURE

Study the accompanying labelled illustration of a microscope to become familiar with the parts of the mechanism.

Magnification is obtained through a system of lenses. The eyepiece combination of lenses is referred to as the "ocular"; the ocular is easily slipped out and for this reason the microscope must always be carried upright. The other lens systems, used in conjunction with the ocular, are the "objectives." There are three objectives, of different magnifying powers, mounted on a revolving nosepiece; by turning the nosepiece, the different objectives may be placed into position.

The magnifying power of the microscope is determined by the power of the ocular multiplied by the power of the particular objective in use. Usually the ocular is 8x or 10x. The objectives are usually 10x, 44x and 95x. Thus:

Ocular	Objectives	Total magnification
10x	10x (low power)	100x.
10x	44x (high power)	440x.
10x	95x (oil immersion lens)	950x.

Magnifying power is expressed in linear dimensions rather than area. Thus an object magnified 100x appears 100 times longer and 100 times wider.

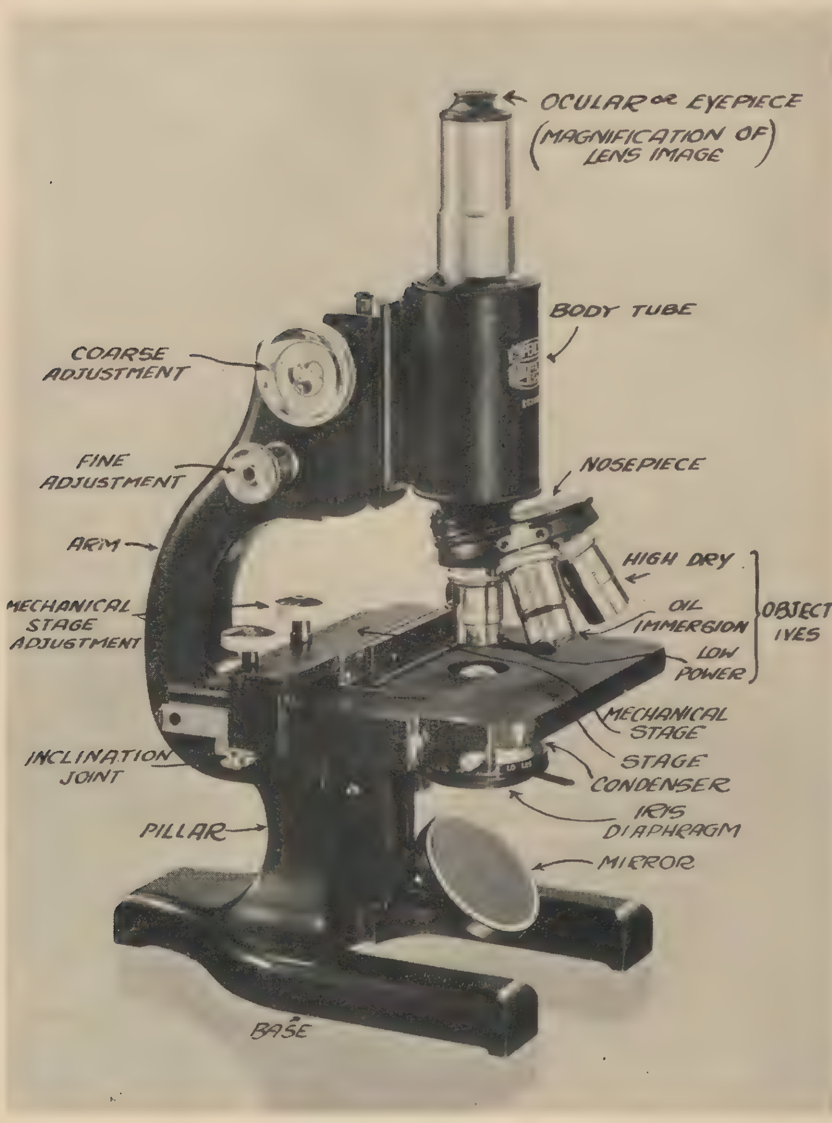


Figure 121. The microscope.

Examine the lighting system. Note that the mirror used to reflect light up through the lenses has two surfaces; one is flat, the other is slightly concave (hollow). The concave side of the mirror is used with artificial light such as the microscope lamp, while the flat surface is used for daylight. The mirror must be adjusted to guide the light up into the

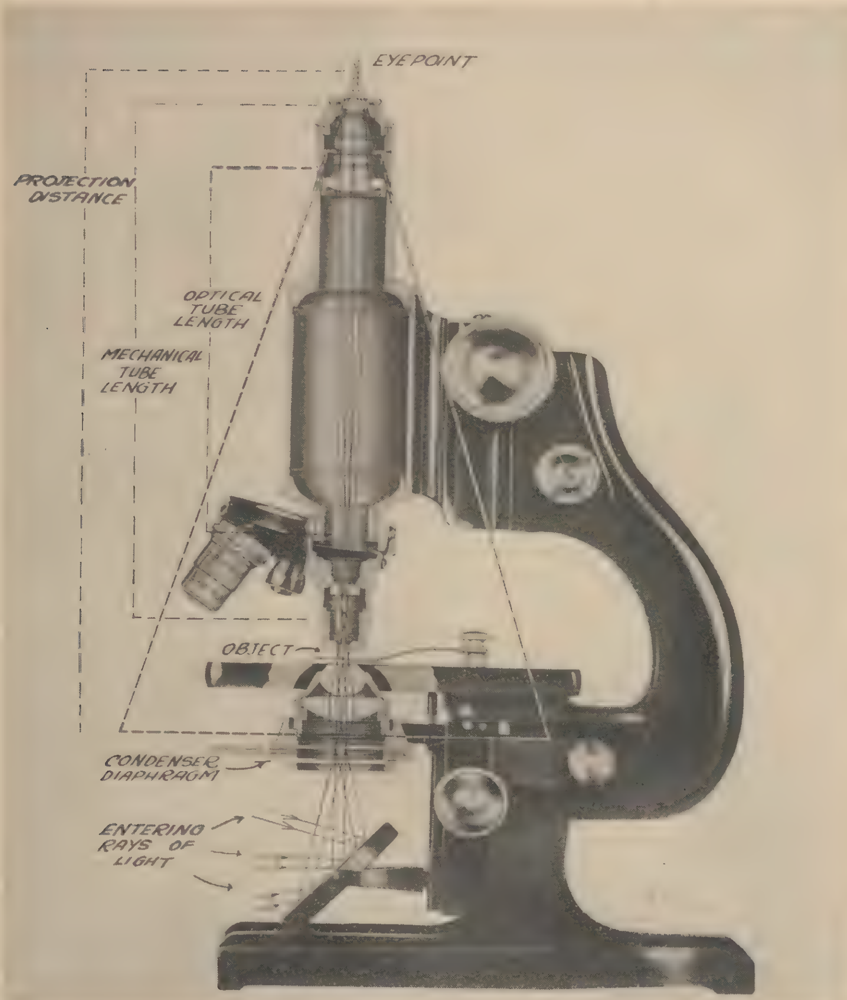


Figure 122. The path of light through the microscope.

lenses. The substage condenser is used to bring the light rays from the mirror into parallel lines so that good light is obtained to pass through the lenses. Note that the condenser may be raised or lowered by a knob just under the stage. An iris diaphragm is contained in the condenser housing. This diaphragm controls the amount of light passing into the lenses. It is exactly the same as the diaphragm that controls light in a camera. Note the lever that makes the diaphragm opening larger or smaller.

Examine the adjustments used for focussing. There are two pairs of knobs; the larger knobs are for coarse adjustment and are used to move the body tube and lenses until the object is in approximate focus; the smaller knobs are the fine adjustment (micrometer-type). This fine adjustment is used only for delicate focussing to clarify the image after a crude image is obtained by use of the coarse adjustment.

To study a preparation under low power or high power, the following procedure is used:

1. Place low power objective into position.
2. Adjust mirror to obtain an evenly illuminated field.
3. Place the preparation on microscope stage.
4. Lower objective almost to, but not touching slide.
5. While looking through the ocular, slowly raise the objective by means of the course adjustment until the material comes into focus.
6. To obtain a sharp focus, the field must be partially darkened. This is accomplished by lowering the condenser and partially closing the iris diaphragm.
7. Obtain exact focus by careful use of fine adjustment.
8. For higher magnification, place the high power objective into position, being careful not to come in contact with the preparation. Focus by use of the fine adjustment.

For detection of bacteria on a slide containing a dry stained smear, or for other work requiring highest possible magnification, the oil immersion lens is used:

1. Place the oil immersion objective into position.
2. Adjust the mirror to obtain an evenly illuminated field.
3. Place a drop of immersion oil on the stained preparation.
4. Place the preparation on the stage of the microscope so that the oil droplet is directly beneath the objective.
5. With the eye at the level of the microscope stage, slowly lower the objective by using the coarse adjustment until it is immersed in the oil and *almost* touching the slide.
6. A maximum amount of light is necessary. This is accomplished by raising the condenser and opening the iris diaphragm completely.
7. Raise the objective very slowly by means of the coarse adjustment until the material is in approximate focus.
8. For exact focus, use the fine adjustment.
9. After study of the specimen is completed, immediately remove the immersion oil from the lens, using only lens paper for this purpose. The oil must not be allowed to dry on the lens. If the preparation is to be kept, the oil should be removed from this also.

Failure to obtain a good image may be due to one of the following faults:

1. The lenses may be dirty. Remove loose particles by careful rubbing of the lenses with lens paper. If grease or hardened dirt is present, moisten the lens paper *slightly* with xylol, brush the lens lightly and immediately rub with dry lens paper. Excess xylol or other solvent may loosen the lenses on some microscopes, and thus any solvent must be used sparingly.
2. The slide may be upside down.
3. The specimen may not be directly below the lens.
4. Objective lens may not be securely in position.
5. Lighting may be inadequate; improper adjustment of mirror, iris diaphragm, or substage condenser; lens in substage condenser may be dirty.

PREPARATION OF SLIDES FOR MICROSCOPIC STUDY

PURPOSE

To prepare slides of specimens for microscopic examination.

MATERIALS

1. Applicator sticks.
2. Cotton.
3. Slides.
4. Cover slips.
5. Burner (alcohol, gas, or electric plate).

PROCEDURE

A. Preparation of a specimen for direct study (wet preparation).

1. Obtain several clean slides and cover slips.

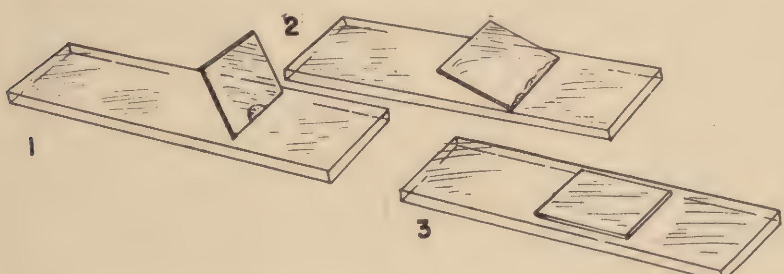


Figure 123. Application of a cover slip to a wet preparation.

2. If the specimen is a fluid, and already sufficiently dilute for study, a drop may be placed on the center of the slide. A clean coverslip is next placed at an angle next to the specimen, as illustrated. Lower the coverslip slowly until it rests flat, and the specimen forms a thin unbroken layer between slide and coverslip. Avoid introducing air bubbles.

3. If the specimen is not fluid, or not sufficiently diluted, place a drop of distilled water on the slide and introduce the specimen into this drop of water. Then apply the cover slip as described above.

4. Be sure to use only one small drop of specimen or of distilled water, since the material must form a thin even layer for best study.

B. Preparation of a direct smear (pus, material from gum infections or throat infections).

1. Obtain the specimen by use of a sterile swab.

2. *Roll* the swab over the surface of a clean slide.

3. Burn the contaminated swab, or in some other manner disinfect and destroy it.

4. Allow the material on the slide to dry.

5. Fix the material to the slide by heating; this can be done by passing the slide several times over a low flame with the specimen-side away from the flame, or by warming the slide on an electric plate.

6. The slide is now ready for staining.

C. Preparation of blood smears is described under Procedures for examination of blood.

STAINING PROCEDURES; BACTERIOLOGICAL

PURPOSE

Bacteria are difficult to observe, even under the highest powers of the microscope. They are much more readily detected when dried upon a glass slide and colored with an appropriate stain. Furthermore, stains are useful in identifying bacteria, and recognizing the specific organisms, since their shape and structure become clearer.

MATERIAL

1. Slide preparations (smears) to be stained.
2. Stains, appropriate, as described below.
3. Alcohol, 95%.

PROCEDURES

A. Procedure for simple one-color stain.

1. Several different stains may be used:

   a. Methylene blue

   Formula:

Methylene blue	3 grams
95% alcohol	30 cc.
.01% solution potassium hydroxide	100 cc.

   Dissolve the methylene blue in the alcohol, then mix with the potassium hydroxide.

   b. Carbol fuchsin

   Formula:

Basic fuchsin (saturated alcoholic solution)	10 cc.
5% aqueous solution carbolic acid	100 cc.

   c. Crystal violet

   Formula:

Crystal violet	5 grams
Aniline oil	2 cc.
Alcohol (95%)	10 cc.
Distilled water	88 cc.

2. Select the stain you wish to use, and flood the smear-area of the slide with this stain.
3. Allow the stain to remain on the slide for about two minutes. (If, upon subsequent study of the slide, the stain is too light, use a longer period for staining; if too dark, shorten the period.)
4. Wash the slide gently with tap water to remove excess stain, and allow to dry. The slide is now ready for microscopic study.

B. Gram stain.

1. Purpose of this stain: The Gram stain involves the use of two colors, and is valuable for differentiating bacteria on the basis of the color they take. This method of staining is of great value in substantiating the diagnosis of gonorrhea, meningitis, and other diseases.
2. Formulae for stains used:

   a. Primary stain

   Solution A:

Crystal violet	1 gram
Distilled water	100 cc.

   Solution B:

Sodium bicarbonate	1 gram
Distilled water	20 cc.

Mix solutions A and B just before use, in the proportion of 30 drops solution A to 8 drops solution B.

b. Mordant (Gram iodine)

Iodine	1 gram
Potassium iodide	2 grams
Distilled water	300 cc.

c. Decolorizer

Alcohol, ethyl, 95%

d. Counterstain

Safranin	2 grams
Distilled water	100 cc.

3. Method of staining:
   a. Prepare smears.
   b. Apply solutions as follows:
      1. Flood slide with primary stain and allow to stand for one minute.
      2. Wash gently in tap water.
      3. Place mordant (Gram iodine) on smear, and allow to remain one minute.
      4. Wash in tap water.
      5. Place slide in 95% alcohol, until no more color "oozes" from smear.
      6. Wash in tap water.
      7. Apply counterstain (safranin) for 30 seconds.
      8. Wash in tap water.
      9. Allow slide to dry.
4. Explanation of this staining technique: Almost all bacteria are stained violet by the primary stain. However, the alcohol used as a decolorizer removes this violet stain from certain bacteria. The bacteria which retain the violet stain are called "gram-positive". Those organisms which lose the violet stain during the decolorization process take on a pink color from the safranin; these organisms are classed as "gram-negative."

C. Acid-fast staining procedure.

1. Purpose of the stain: The acid-fast stain is used to detect and identify certain bacteria, especially the causative organism of tuberculosis.
2. Formulae for stains used:
   a. Primary stain (basic fuchsin)

   Dissolve 8 grams of basic fuchsin in 100 cc. 95%

ethyl alcohol. To 10 cc. of this solution add 90 cc. 5% phenol; then filter.

b. Acid alcohol

Alcohol, ethyl, 95%	97 cc.
Hydrochloric acid	3 cc.

c. Counterstain.
Methylene blue.

3. Technique:
   a. Prepare a smear of the material (sputum from suspected case of tuberculosis). Allow the smear to dry.
   b. Fix the smear by heat.
   c. Apply solutions as follows:
      1. Flood the slide with carbol fuchsin. Warm the slide until steaming is noted; during this process, add more carbol fuchsin to prevent the slide from drying. Continue this steaming process for three minutes. Avoid excessive heat; use just sufficient heat to cause gentle steaming.
      2. Wash the slide in acid alcohol until the color no longer "oozes" from the smear.
      3. Wash in water.
      4. Counterstain lightly with methylene blue (one minute).
      5. Dry.

4. Explanation of this staining technique: Acid-fast bacteria, such as those causing tuberculosis, retain the carbol fuchsin stain (red); the non-acid-fast bacteria do not retain the red, but are colored blue by the counterstain.

URINALYSIS

PURPOSE

To perform the tests required for routine analysis of urine.

MATERIALS

1. Urine sample
2. Test tubes
3. Urinometer
4. Microscope
5. Centrifuge
6. Slide and cover slip
7. Litmus paper
8. Benzidine
9. Acetic acid
10. Hydrogen peroxide
11. Wood pulp paper
12. Dilute hydrochloric acid

PROCEDURE

A. Sampling. Obtain a specimen of urine for examination. Use the first urine voided after sleep.

B. Physical examination.

1. Note the color: Normal variation ranges from yellow to amber, depending upon concentration. Blood, bile, and various drugs or poisons may cause color abnormalities.
2. Observe transparency and sediments (sample must be fresh). Normal urine is usually clear if the sample is fresh. (It may be cloudy due to the presence of phosphates or urate crystals). In abnormal conditions, cloudiness may be due to pus, bacteria, shreds or blood.
   Record as:
   clear
   slightly cloudy
   cloudy
3. Odor: Normally, urine is aromatic. It may become ammoniacal during decomposition; fruity odors may be noted in diabetes. Diet or drugs may impart special odors.
4. Specific gravity: This is measured by use of the urinometer.

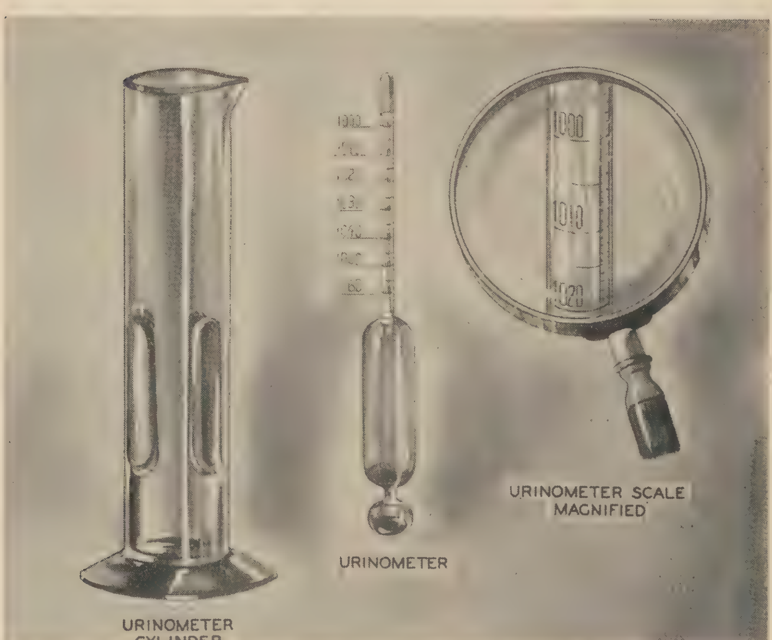


Figure 124. The urinometer.

a. Place urine in the urinometer cylinder, using care to avoid bubbles; do not fill the cylinder completely, but enough to allow the urinometer to float.
b. Introduce the urinometer into the urine in the cylinder so that the urinometer floats freely, without touching the sides or bottom of the cylinder.
c. Read the urinometer, and record.

5. Microscopic examination of sediment: specimens should be examined while fresh.
   a. Method used to prepare material:
      1. Mix urine sample well and fill a graduated centrifuge tube to the 15 cc. mark.
      2. Centrifuge at 1500 revolutions per minute for five minutes (if centrifuge is not available, allow urine to stand for about six hours so that sediment may settle to the bottom.)
      3. Pour off supernatant fluid, leaving a small amount at the bottom of the centrifuge tube.
      4. Stir the sediment, and pour a small drop on a clean slide.
      5. Cover with cover glass.
      6. Examine immediately.
         a. Low power objective is used first to locate structures.
         b. High power objective is then used to identify smaller structures (pus cells, blood cells, casts).
   b. Classification of sediment:
      1. Normal findings:
         a. Amorphous phosphates or urates.
         b. Uric acid crystals.
         c. Calcium oxalate crystals.
         d. Triple phosphate crystals.
         e. Epithelial cells.
         f. Occasional pus cells.
         g. Occasional red blood cells.
         h. Spermatozoa.
         i. Mucous shreds.
      2. Abnormal findings:
         a. Casts.
         b. Cylindroids.

c. Pus cells (more than 3 per high power field).
d. Red blood cells (more than 2 per high power field).

3. Extraneous findings:
a. Yeast cells.
b. Molds.
c. Fibers of cotton, wool, etc.
d. Oil droplets.
e. Contaminating bacteria.

C. Chemical analysis.

1. Reaction: Normal freshly voided urine is acid, but may become neutral or slightly alkaline after standing. Determination of reaction may be made by use of an indicator, litmus paper, which is satisfactory for crude tests.
Dip the end of a piece of litmus paper into the urine sample:
a. Blue litmus will turn red if the sample is acid.
b. Red litmus will turn blue if the sample is alkaline.
c. If neither color changes, the urine may be considered neutral.

2. Sugar: Benedict's test for sugar will reveal the presence of glucose sugar (also called dextrose). This is a *qualitative,* not a *quantitative* test, i.e., it will show whether or not sugar is present, but cannot be used to determine the actual amount of sugar.
a. Put 5.0 cc. of Benedict's reagent into a test tube.
b. Heat to boiling point; if the reagent is good, no change should occur.
c. Add 8 drops of urine to the reagent and mix thoroughly.
d. Boil for 1-2 minutes.
e. Allow to cool slowly.
f. Note the results.
1. If the solution remains clear, or shows only a faint blue color, the test is negative for sugar.
2. If a red, yellow, or green precipitate forms, the test for sugar is positive.

3. Albumin:
a. Heat and acetic acid test:
1. Fill test tube ¼ full of urine.
2. Boil.

3. Add 5 drops of 5% acetic acid.
4. A white precipitate indicates albumin. (If a precipitate forms during boiling but disappears when acid is added, such precipitate indicates the presence of phosphates, not albumin.)
5. Record results as:
    a. Negative.
    b. Small amount.
    c. Moderate amount.
    d. Large amount.

4. Benzidine test for occult blood:
The benzidine test reveals the presence of minute quantities of blood which cannot be detected microscopically.
    a. Put 2 cc. of glacial acetic acid into a test tube.
    b. Add a pinch of benzidine powder to the acetic acid.
    c. Add 2 cc. of hydrogen peroxide to the mixture.
    d. Then add 2 cc. of urine.
    e. Note the results.
        1. If the solution remains milky white, the test is negative.
        2. If the solution turns blue-green or blue in color, blood is present.

5. Bile:
    a. Crude test:
        1. Shake 5 cc. of urine in a test tube.
        2. A greenish froth indicates bile.

CLINICAL RECORD

Examination of Urine

Quantity (24 hour specimen) ....

Odor ....

Color ....

Transparency ....

Specific Gravity ....

Microscopic Examination:

Epithelial cells ....

Crystals ....

Red blood cells ....

Pus cells ....

Casts ....

Miscellaneous findings ....

....

....

Chemical Examination:

Reaction ....

Albumin ....

Sugar ....

Bile ....

Occult blood ....

PREPARATION OF A BLOOD SMEAR

PURPOSE

A few drops of blood should be obtained by skin puncture, and spread into thin films on slides for microscopic study. The use of Wright's stain enables detailed study of the blood cells.

MATERIALS

1. Needle.
2. Absorbent cotton.
3. Alcohol, 70%.
4. Microscope slides.

PROCEDURE

A. Obtain blood by skin puncture.

1. Select site for puncture. The tip of the middle finger is usually preferred, although the ear lobe may be used.

2. Moisten cotton with 70% alcohol and rub this puncture site to clean the area and stimulate circulation.

3. Allow the skin to dry.

4. Although any good quality needle may be used, special needles such as the Hagedorn type are available. It is desirable to mount the needle in a holder for convenience in handling; this may be improvised by embedding the blunt end of the needle in a cork or rubber stopper.

The needle may be sterilized by flaming before use, or by immersion in 70% alcohol for at least three minutes.

5. Pull the skin taut over the site selected for puncture. Avoid contamination of the skin.

6. Puncture the skin 1/8 inch deep by means of a quick jab.

7. Wipe away the first drop of blood, using dry absorbent cotton. The subsequent drops of blood may be used for whatever preparations are desired.

B. Preparation of a blood smear.

1. Obtain several clean slides, which are free from any dirt or grease. Slides should be washed in soap and water, thoroughly rinsed in water, then rinsed in alcohol and air-dried.

2. Perform a skin puncture, as described above, and discard the first drop.

3. Place the second drop of blood on a clean slide.

4. Place the end of another slide next to the drop as illustrated. Allow the blood to spread across this area, then pull the drop of blood over the surface of the first slide to form a thin uniform film.

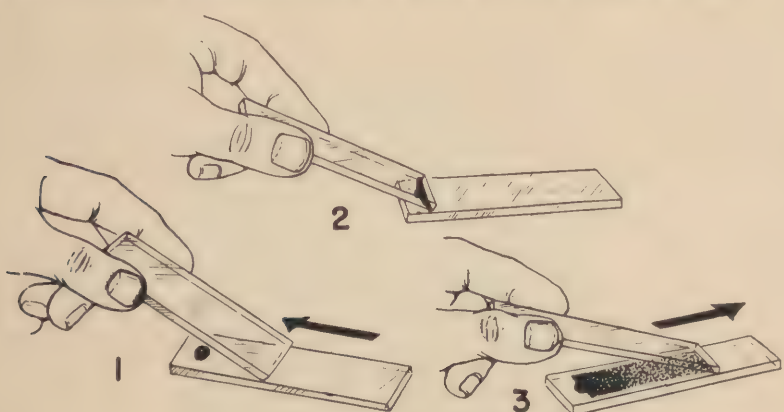


Figure 125. Preparation of blood smear.

5. Allow the slide to dry. Meanwhile, it may be desirable to prepare a second slide in the same manner.

C. Technique for Wright's stain of blood smear.

1. Obtain Wright's stain (this can be prepared by dissolving tablets of stain in methyl alcohol).

2. Cover the smears completely with Wright's stain for one minute.

3. At the end of this minute, allow the stain to remain, but add an equal volume of distilled water and allow to stand for two minutes.

4. Wash slide in tap water, and dry in air.

RED BLOOD COUNT

PURPOSE

To determine the number of red blood corpuscles per cubic millimeter of blood.

MATERIALS

1. "Red count" pipet.
2. Counting chamber and special cover slip.
3. Diluting fluid:
   - a. Hayem solution:
     1. Mercuric chloride .... 0.5 gram
     2. Sodium sulfate .... 5.0 gram
     3. Sodium chloride .... 1.0 gram
     4. Distilled water .... 200 cc.
   - or b. Sodium citrate, 3%.
4. Microscope and lamp.
5. Equipment for skin puncture.

PROCEDURE

1. Set up the microscope.

2. Study the counting chamber. Locate the ruled area, and then locate the central part of this area. Here, one square millimeter is divided into 25 squares; each of the latter in turn is subdivided into 16 squares. Refer to the accompanying illustration.

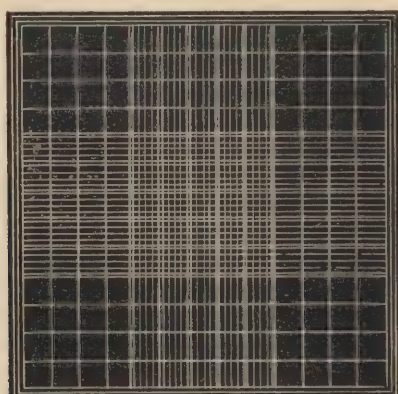


Figure 126. Ruled area of counting chamber, magnified.

3. Place the counting chamber cover slip in position; it will rest on glass platforms on both sides of the ruled area, so that it will be elevated 0.1 millimeter above the rule marks.

4. Perform finger tip puncture, as previously described.

5. Wipe away the first drop of blood.

6. Place the tip of the "red" pipet against the next drop of blood, and draw blood up to the 0.5 mark on the pipet.

7. Wipe the tip of the pipet on lens paper to remove excess blood.

8. Dip the pipet into the dilution fluid (Hayem solution or 3% sodium citrate) and draw up to the mark 101 (above bulb).

9. Hold the pipet horizontally, placing a finger over each end, and shake vigorously in an up and down motion for ½ minute.

10. Discard the first few drops, since these were in the capillary portion of the tube and may not be thoroughly mixed.

11. Place the tip of the pipet at the edge of one side of the counting chamber near the ruled area, and expel the fluid just under the cover slip. In this way, a layer 0.1 millimeter in thickness is formed between the cover slip and the ruled area of the chamber.

12. The specimen is now ready for count under high power:
    a. Locate the square millimeter which contains the 25 divisions previously mentioned.

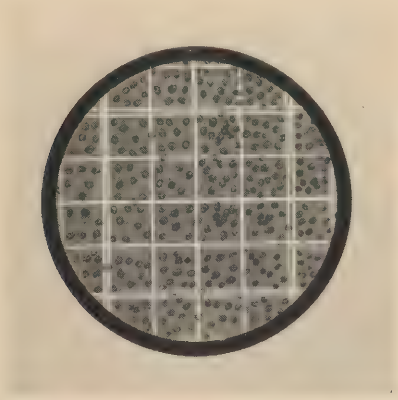


Figure 127. Red blood count; high power view of filled counting chamber.

    b. Count all of the red corpuscles in *one* of these 25 divisions, and record the number. (The 16 subdivisions are simply useful in aiding the count in the larger division, since each of the 16 may be counted separately, then added.) A policy must be adopted regarding the corpuscles on the line to avoid counting them twice or omitting them altogether. Therefore, count the cells which lie on the left line and the upper line, and do *not count* the cells which lie on the

right line and lower line. If this is done for each of the adjacent squares, the total should be accurate.

c. Repeat the above counting procedure on four more of the 25 divisions, and add these four totals to the one obtained in (b), thus deriving the sum total of corpuscles in 5 of the 25 divisions.

d. Multiply this sum total by 10,000, because actually the count included only 1/10,000 of a cubic millimeter of blood, as explained below:

   (1) In the pipet, the blood was diluted 1:200 (hence multiply by *200*).

   (2) The layer of blood was only 0.1 of a millimeter in thickness (hence multiply by *10*).

   (3) The *area* counted was only 1/5 of a square millimeter (5 out of 25 squares were counted) (hence multiply by *5*).

   (4) Note that 200 x 10 x5 equals 10,000; this is the number by which the actual count must be multiplied.

e. The asnwer is recorded as number of red corpuscles per cubic millimeter of blood.

WHITE BLOOD COUNT

PURPOSE

To determine the number of leucocytes per cubic millimeter of blood.

MATERIALS

1. "White count" pipet.
2. Counting chamber with cover slip.
3. Diluting fluid, 2% solution of acetic acid.
4. Microscope and lamp.
5. Equipment for skin puncture.

PROCEDURE

1. Set up the microscope.
2. Secure clean counting chamber with a cover slip in position.
3. Perform finger tip puncture.
4. Wipe away the first drop of blood.
5. Place the tip of the "white" pipet against the second drop of blood, and draw blood up to the 0.5 mark.
6. Wipe excess blood from tip of pipet.

7. Dip the pipet into the diluting fluid (2% acetic acid) and draw up to the 11 mark. This effects a 1:20 dilution. At the same time, the acetic acid dissolves the red corpuscles so that these will not confuse the white count.

8. Holding the pipet horizontally, place the fingers over both ends and shake vigorously in an up and down motion for ½ minute.

9. Discard the first few drops.

10. Introduce the fluid into the countiing chamber over the ruled area, between the chamber and cover slip.

11. Using the low power objective of the microscope, focus on the one-millimeter squares at the outer portion of the ruled area. Count the number of leucocytes in each of four square millimeters, and total these.

12. Multiply this total by 50 to secure the final answer in terms of number of leucocytes per cubic millimeter of blood. The reason for this multiplication is explained by the following formula:

$$\frac{\text{number of cells counted}}{4} \times 10 \times 20 = \begin{array}{l}\text{number of leucocytes}\\ \text{per cu. mm. of blood}\end{array}$$

a. Division by 4 is necessary, since 4 squares were counted and the figure desired is the average for one square millimeter.

b. Multiplication by 10 is necessarry since the area counted was only 0.1 mm. deep.

c. Multiplication by 20 compensates for the original dilution of 1:20.

d. Rather than to divide by 4. and then to multiply by 10 and by 20, the same results are achieved through direct multiplication by 50.

DIFFERENTIAL BLOOD COUNT

PURPOSE

To determine the proportion of the various leucocytes in a blood smear.

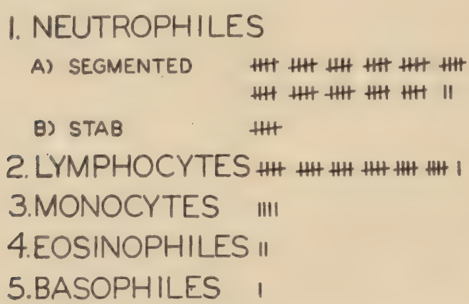
MATERIALS

1. Microscope.
2. Lamp.
3. Blood smears, stained with Wright's stain.
4. Immersion oil.

PROCEDURE

1. Obtain smears of the blood to be examined; these smears should be stained with Wright's stain.

2. Examine these smears under the oil immersion lens as follows:
   a. Select four good areas on the blood film and place a drop of oil on each.
   b. Focus the oil immersion lens on one of these areas, and identify each of the different leucocytes observed, recording observations as indicated below. Count 25 leucocytes in this area by moving the slide across, forward, across, etc. Then repeat this performance in each of the remaining three areas. The count is based upon a total of 100 leucocytes observed.
   c. Recording can best be performed as follows:



   d. Normal proportions includes the following ranges:
      1. Neutrophiles
         a. segmented 56–62%.
         b. stab 4–8%.
      2. Lymphocytes 25–33%.
      3. Monocytes 2–6%.
      4. Eosinophiles 1–4%.
      5. Basophiles 0–1%.

HEMOGLOBIN ESTIMATION

PURPOSE

To determine the amount of hemoglobin in blood.

MATERIALS

1. Equipment for skin puncture.
2. Tallquist hemoglobin scale (comparator chart) for crude estimation.
3. If more accurate results are necessary, a Sahli hemoglobinometer is recommended.

PROCEDURE

A. Crude hemoglobin estimation; Tallquist scale.

1. Perform a skin puncture.

2. Discard the first drop of blood.

3. Place the second drop of blood on a piece of white absorbent paper supplied with the Tallquist scale.

4. Match the color of this specimen against the colors on the Tallquist chart.

5. Record the percentage indicated from this chart.

B. Estimation by the Sahli hemoglobinometer.

1. Principle of this method: The Sahli apparatus consists of a standard comparison tube plus equipment to convert the hemoglobin of the blood sample into acid hematin. The amount of dilution required to make the color of the specimen match the standard is measured, and is used to determine the hemoglobin content.

2. Technique:

   a. Place N/10 hydrochloric acid solution (1 cc. concentrated hydrochloric acid in 99 cc. distilled water) in the graduated test tube to mark 10.
   b. Draw drop of blood to 20 cu. mm. mark on pipet.
   c. Blow the contents of this pipet into the hydrochloric acid solution in test tube. (Hemoglobin is changed to acid hematin—brown in color).
   d. Place the test tube beside the comparison tube; add distilled water drop by drop, mix by closing test tube with finger and inverting, until the tubes are the same in color.
   e. Note amount of hemoglobin.

COAGULATION TIME OF BLOOD

PURPOSE

To determine the length of time required for a drop of the patient's blood to coagulate; the result is compared with standard figures.

MATERIALS

1. Glass capillary tubing, or glass tubing and Bunsen burner.
2. Equipment for skin puncture.

PROCEDURE

1. Obtain a glass capillary tube about three inches long. If none is available, capillary tubing may be made as follows:

   a. Rotate center portion of glass tube over flame until it becomes red hot (glows).

b. With one rapid motion, pull the ends of the tube outward in a straight line. The heated portion of the tube will have stretched into a narrow capillary tube having a bore of approximately 1 mm.

c. Using an ampule file, file off approximately three inches of this narrow capillary tube.

2. Perform a skin puncture.
3. Note time when blood appears.
4. Hold tip of this capillary tube in drop of blood on finger tip, and allow tube to fill by capillary attraction.
5. After 1 minute, break off one end of the tube.
6. Repeat this procedure at half minute intervals.
7. Note the time when a thread of fibrin is first seen extending between the broken portions of the tube. The length of time required for this fibrin thread to form is known as "coagulation time."

BLEEDING TIME

PURPOSE

To determine the length of time required for a small skin puncture to cease bleeding.

MATERIALS

1. Equipment for skin puncture.
2. Absorbent paper.

PROCEDURE

1. By methods previously described, puncture the skin of the middle finger, causing it to bleed freely.
2. Note the time that bleeding begins.
3. At half-minute intervals, blot with absorbent paper.
4. Note and record the time bleeding ceases.

BLOOD TYPING AND CROSS-MATCHING

PURPOSE

To type blood for determination of blood group; also to determine compatibility of the blood of two persons by direct "cross-matching" of blood samples.

MATERIALS

1. Blood grouping serum; Anti–A.
2. Blood grouping serum; Anti–B.
3. 1 clean double-hollow ground slide.
4. 3 clean capillary pipettes.

5. 70% alcohol.
6. Sterile needle.
7. Normal saline.
8. Clean Kahn tubes (5).
9. Microscope.

PROCEDURE

A. Blood typing.

1. Place 2.0 cc. of normal saline into a Kahn tube.

2. Using the same methods as in previous blood work, obtain blood from the finger-tip. Discard the first drop. Allow the second drop to fall into the saline in the Kahn tube. If blood touches the side of the tube, incline and rotate the tube so that the blood is mixed with the saline. Agitate the mixture. This is the red cell suspension.

3. Obtain a clean double-hollow ground slide. In one concavity, place a drop of Anti–A typing serum. In the other concavity of the same slide, place a drop of Anti–B typing serum. For convenience, commercial typing serum is sometimes colored (blue for Anti–A and red for Anti–B) to help avoid error.

4. Add one drop of the red cell suspension to each of the two sera in the concavities.

5. Watch for agglutination (clumping of red cells in either or both of the mixtures). If agglutination does not occur within a few minutes, the slide should be observed at 3 to 5 minute intervals for 20–30 minutes, since the reaction may be a delayed one. Rotate the slide frequently to get a good mixture. If the reaction is delayed, do not keep the slide

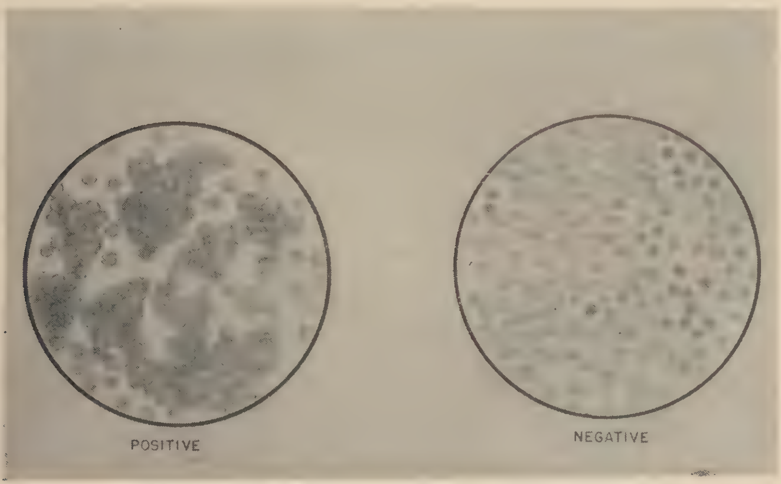


Figure 128. Agglutination reactions of red blood cells.

in the light of the microscope during the 20–30 minute period, since the heat may cause undesirable evaporation.

6. Interpretation of results.

Agglutination by the Anti–A serum shows that A is present and agglutination by the Anti–B serum shows that B is present in the corpuscles. The following table shows to which group the blood belongs as determined by the above-described agglutination results:

	Blood Groups (International)			
	O	A	B	AB
Anti-A serum	−	+	−	+
Anti-B serum	−	−	+	+

Even though blood typing is performed, the *Compatibility Test,* described below, *should also be used before transfusion.* This is necessary to eliminate the dangers of special sub-groups. These are not revealed by typing, but *will* show up in compatibility tests (direct matching of blood from two persons).

B. Test for compatibility.

The compatibility test by cross-matching is in itself sufficient to be used in determining the safety of a transfusion; however, if typing is done first, it will eliminate many of the donors whose blood would certainly be incompatible; also typing will serve as a safety check in case of any technical errors in cross-matching. Thus, the best procedure is to type as well as cross-match.

1. Place 2 cc. of normal saline in a Kahn tube labelled "DONOR'S CELLS."

2. By the technique of venipuncture, 3 to 4 cc. of blood is obtained from the donor.

3. Allow one drop of donors blood to fall into the 2 cc. of saline in the tube marked "DONOR'S CELLS." This is the red blood cell suspension of the donor. Agitate the tube to get a good suspension.

4. Place the remainder of the donor's blood into a Kahn tube labelled "DONOR'S SERUM." Allow the blood to clot; separate the clot from the

Figure 129. Slide for compatibility test:
PS = patient's serum, DC = donor's cells.
DS = donor's serum, PC = patient's cells.

serum by means of an applicator stick. Allow clotted material to settle, leaving a clear straw-colored serum above the sediment.

5. Perform the same procedure for the recipient's blood, this time labelling the tubes as "PATIENT'S CELLS" and "PATIENT'S SERUM."

6. Mark a clean double-hollow ground slide as follows:

7. In the depression on the left end of the slide, place one drop of PATIENT'S SERUM and add one drop of DONOR'S CELLS.

8. In the depression on the right end of the slide, place one drop of DONOR'S SERUM and add one drop of PATIENT'S CELLS.

9. Rotate the slide to get a good mixture.

10. Examine under low power of microscope for agglutination.

11. Interpretation of results: If, within an hour, no agglutination takes place at all, the blood of donor and blood of patient are compatible. If agglutination occurs in either of the mixtures, the blood of patient and donor are not compatible.

GLOSSARY OF GENERAL TERMS

A

$\overline{aa}$	of each
abrasion	an area where skin or mucous membrane has been rubbed away
a.c.	before meals
abscess	a localized area of pus in a cavity formed through decomposition of tissue
acute	of short duration, usually severe
ad lib.	as desired
allergy	hypersensitivity
ampul	sealed glass container of sterile substances intended for parenteral administration
anatomy	the science dealing with the structure of the body and the relation of its parts
anorexia	loss of appetite
anterior	on or toward the front of the body with the body in the anatomical position
analgesics	drugs which relieve pain
anodynes	drugs which relieve pain
anesthetics	drugs which produce local or general insensibility
antacids	drugs which will decrease the acid content of the stomach
anthelmintics	drugs used to destroy or expel intestinal worms
antibiosis	the antagonistic effect of one species of organism (or its products) upon another species of organism
antipyretics	drugs used to reduce body temperature if fever is present
antiseptic	an agent that will prevent the growth or arrest the development of micro-organisms
apex	the tip or pointed end of any cone-shaped structure
aqueous	watery preparation using water as a solvent
aromatic water (aqua)	saturated solution of volatile substances in distilled water
asymptomatic	showing no symptoms
atrophy	wasting away of a tissue or structure, usually due to a lack of nutrition commonly resulting from a lack of use
autoclave	an apparatus using steam under pressure for the purpose of sterilization
avulsion	the tearing away of a part (tissue or structure)

B

bacillus	a rod-shaped bacterium
bacterium (pl-bacteria)	a microscopic one-celled organism which reproduces by division
barbiturate	a drug which contains barbital or barbital derivatives
b.i.d.	twice daily
bleb	a skin vesicle filled with fluid
blister	a localized collection of fluid within the skin layers
B.M.R.	basal metabolic rate
B.P.	blood pressure

GLOSSARY OF GENERAL TERMS

C

c̄	with
capsule	soluble gelatin shell used to enclose a dose of a medicine
cardiac	pertaining to the heart
care; deck	treatment given to victim at scene of accident
care; sick bay	continued and complete treatment of a victim after removal to sick bay
carrier	a person who harbors and disseminates disease-producing micro-organisms, but shows no external signs of disease
catharsis	a cleansing or "purging"
cathartic	a medicine which increases the evacuation of bowel contents
catheter	a tubular instrument for removing fluids from a cavity
catheterization	passage of catheter to remove urine from the bladder
caustic	burning or corrosive
chronic	of long duration
-cele	suffix meaning a sac
centigrade	a measure having one hundred degrees or grades
cervical	pertaining to the neck
chemotherapy	the use of a specific drug to treat a specific disease
chill (noun)	an attack of shivering; involuntary contractions of voluntary muscles, accompanied by sensations of cold
coagulate	to clot
coccus	a spherical bacterium
compress (noun)	a pad of folded cloth applied to a body area, usually to provide pressure and/or medication
contagious	capable of transmission from person to person, usually by direct contact
contamination	the probable presence of organisms on article or body
contraindication	a condition which renders some particular course of treatment improper or undesirable
contusion	a bruise
convulsion	violent involuntary contraction of the muscles, usually lacking coordination
crepitation	abnormal sound, as of bone rubbing together
cyanosis	blue discoloration of tissue due to a lack of oxygen supply in the blood
cyst	a sac, especially one containing fluid or semi-fluid material

D

debridement	removal of foreign matter and damaged tissue from a wound
decant	the act of pouring off a supernatant fluid, i.e. the fluid remaining after sediment has settled out of a suspension
derma	skin
dermatitis	inflammation of the skin
desquamation	peeling or scaling of the skin
detergent	a substance used to cleanse or purify
devitalization	the process of depriving of life, as in the case of tissues which suffer serious damage
diagnosis	the recognition and identification of a disease or injury

diarrhea	fecal discharge of abnormal liquidity and frequency
diffuse	not limited or localized
disease, functional	a disease involving a change in the body function, but not in the structure
disinfection	the process of destroying pathogenic micro-organisms
disinfection, concurrent	the destruction of pathogenic micro-organisms in the immediate surroundings of the infected person during the period of illness
disinfection, terminal	the destruction of pathogenic micro-organisms in the environment after the recovery or removal of the diseased person
disinfestation	the process of destroying insects or animals that are capable of carrying or transmitting disease
dislocation	the displacement of a part, especially a bone
distal	farthest from the center, or origin
distention	the state of being enlarged
distillation	the process of converting a liquid to a vapor and condensing the vapor back to a liquid
desiccation	the process of removing moisture from a substance at moderate temperature
drug	(1) articles recognized in the official United States Pharmacopoeia, or the official National Formulary, or any supplement to these; and (2) articles intended for use in the diagnosis, prevention, cure, mitigation or treatment of disease in man or other animals
dys-	prefix meaning painful or difficult
dyspnea	labored breathing

E

ecchymosis	abnormal color of skin due to extravasation of blood
-ectomy	suffix meaning removal of
edema	diffuse collection of subcutaneous fluid, causing enlargement of area affected
EENT	ear, eye, nose and throat
effusion	the escape of a fluid into a tissue or part; also used as a noun, applied to the fluid itself
elixirs	sweetened, aromatic, hydro-alcoholic solutions of medicinal agents intended for internal use, or as vehicles for medicinal substances
emergency treatment	the rendering of first aid by the Hospital Corpsman at the scene of the accident or illness, provision of proper transportation to the sick bay and the additional sick bay care pending the arrival of a medical officer
emesis	the act of vomiting
emollient	softening or soothing of irritated tissue; or, an agent which has such effect
emulsion	an aqueous preparation in which oily or resinous substances are suspended
endemic	prevailing more or less continuously in a particular locality
enema	an injection of fluid into the rectum
entero	intestine

epidemic	an out-break of a disease in a given area affecting and spreading to a large number of people at the same time
epigastric	in front of the stomach
eruption	a visible lesion of the skin due to disease; shows redness, prominence, or both
erythema	redness of skin, or area of skin, produced by congestion of capillaries
etiology	the study of the causes of disease or injury
evacuate	to empty
evaporation	the conversion of liquid into a vapor
exanthem	eruption of the skin; skin rash
excision	cutting away of tissues from a wound
excreta	waste matter cast out of the body
excretion	the act of eliminating waste matter from the body
exsiccation	the process of removing water of crystallization from a substance by the use of strong heat
extravasation	the escape or discharge of material from vessels into the tissues
exudate	a substance deposited in or on a tissue by a vital process or disease

F

feces	material discharged from the bowel
fever	elevation of temperature above normal
fibrin	an insoluble protein formed from fibrinogen during the clotting of blood
filtration	the process of separating liquids from solids by passing the liquid through a porous medium
fission	a method of cellular reproduction during which the cell divides by splitting into two or more parts
flex	to bend
fluidextract	liquid preparation of vegetable drugs, containing alcohol as a solvent, prepared by the process of percolation and distilling the percolate so that 1 cc. represents 1 gram of the crude drug
fracture	the breaking of a part, usually a bone
fumigation	the process of destroying vermin by the application of a gas, vapor, or smoke
fungicide	a preparation which kills fungi
fungus	a vegetable organism of low order of development; includes molds

G

gangrene	death of tissue, usually resulting from faulty blood supply, often accompanied by invasion by micro-organisms which live on dead tissue
gastro-	prefix, referring to the stomach
G.I.	gastro-intestinal
gtt.	drop
G.U.	genito-urinary

H

hematemesis	bloody vomitus
hema	pertaining to blood
hematoma	a localized collection of blood in tissue beneath the skin
hemoptysis	a coughing up of blood
hemorrhage	blood escaping from its normal channels
hepato	pertaining to the liver
hernia	the protusion of a portion of an organ through an abnormal opening
h.s.	hour of sleep or bedtime
hydro	water
hygiene	the science of health which emphasizes the proper care of the human body
hypo-	prefix meaning below; or, less than normal
hyper-	prefix meaning above; or, greater than normal
hyperemia	excessive blood in the specified area

I

I and D	incision and drainage
iliac	pertaining to the hip
I.M.	intramuscular
immunity	the power to resist or overcome an infection
immunization	the process of rendering a subject immune or resistant to an infection
incision	a cut or wound
incubation period	the time between the exposure to a disease and the day on which the first symptoms appear
infection	state in which organisms consume tissue or their toxic products poison tissue
inferior	on or toward the lower end of the body with the body in the anatomical position
infestation	invasion by animal parasites, usually large parasites on the surface of the body.
inflammation	a reaction of poisoned or damaged tissue in which there is redness and warmth due to enlargement of blood vessels, swelling due to edema, and some degree of pain or irritation of nerves
infusion	introduction of fluid
initial dose	pertaining to the first dose
injection	the act of introducing a fluid into a part
inter-	prefix indicating between
intra-	prefix indicating within
irrigant	an agent used in irrigation
irrigation	washing by means of a stream of water or other fluid
irritate	to stimulate, usually to an excessive degree
isolation	the process of segregating persons ill with a communicable disease from others who may be susceptible
I.V.	intravenous

GLOSSARY OF GENERAL TERMS

L

laceration	the act of tearing, or a wound produced by tearing
larva	an immature stage in the life history of an animal during which time it is unlike the parent
lateral	toward the side
laxative	a mild cathartic
lesion	a break in the continuity of a tissue
ligation	the act of tying off a blood vessel
liniment	an oily, soapy, or alcoholic preparation intended for external use to produce a counter-irritant effect
lotion	an aqueous preparation containing suspended medicinal substances intended to be applied externally

M

macule	a discolored spot on the skin not elevated above the surface
magma (gel)	an aqueous suspension of insoluble or nearly insoluble inorganic substances
malaise	uneasiness, discomfort, or distress
malnutrition	imperfect assimilation and nutrition
medial	toward the middle
metabolism	the sum of all physical and chemical changes occuring in the body
micron	about 1/25,000 part of an inch—used as a unit of measure for bacteria
morbidity	the sick rate or proportion of healthy to diseased individuals in a community
mucoid	composed chiefly of mucus
mucus	a viscid watery secretion that covers the mucous membranes
myo-	prefix meaning muscle

N

nausea	sickness at the stomach
necrosis	death and decomposition of tissue
nephro-	prefix meaning kidney
neuro-	prefix meaning nerve

O

occlusion	the act of closure or state of being closed
o.d.	every day
ointment	a semisolid, fatty preparation of medicinal substances intended for external application
osteo-	prefix meaning bone
oto-	prefix meaning ear
-otomy	suffix meaning incision of

P

palpation	the act of feeling with the hands
palpitation	unduly rapid action of the heart felt by patient
pandemic	a wide spread or world wide out-break of disease
papule	a small solid elevation of the skin
parasite	an organism which lives upon or within another organism and at whose expense it obtains advantage without compensation
parenteral	not given through the alimentary canal
pathogenic	giving rise to disease
pasteurization	the process of heating a material to a sufficient temperature for a sufficient time to destroy pathogenic organisms without interfering with the quality of the material treated
p.c.	after meals
pediculosis	a condition of louse-infestation
percussion	the production of sounds by striking the part with short sharp blows
peri-	prefix meaning around
peripheral	pertaining to or located on the surface
physiology	the function of an organism and its parts
pneumo	pertaining to the lung
P.O.	by mouth
poison	a substance which when applied to the body, ingested, inhaled, or developed within the body causes disturbances of function
posterior	on or toward the back of the body with the body in the anatomical position
potent	powerful
p.r.n.	when necessary
prognosis	prediction of the course or probable outcome of a disease or injury
prophylaxis	the observance of rules or carrying out measures necessary to prevent a disease from developing
protozoa	animals whose bodies consist of a single cell
proximal	near the center
pill	a round, oval or globular dosage form of medicinal substances intended for internal administration
purulent	composed chiefly of pus
pus	a fluid or semi-fluid product of inflammation, containing broken-down tissue cells
pustule	a small elevation of skin, filled with pus
putrefaction	decomposition of animal or vegetable matter
putrid	characterized by putrefaction, rotten
pyo-	prefix meaning pus
pyogenic	pus producing

Q

q.h.	every hour
q.i.d.	four times a day
q.s.	a sufficient quantity
quadrant	one quarter of a circle
quarantine	detention of healthy individuals who have been exposed to a disease and are susceptible to that disease

R

rash	a temporary eruption on the skin
recurrent	returning after intermissions
retract	to draw back
rupture	forcible tearing or breaking

S

sanitation	the establishment and maintenance of favorable environmental conditions which will be conducive to healthful living
secretion	the process of separating various substances from the blood
serous	pertaining to or resembling serum
serum	the clear portion of blood which separates out after clotting
sinus	a cavity or hollow space
solute	the substance dissolved in a liquid
solution	a homogeneous mixture in which a substance is mixed with a liquid and is completely dissolved in it. The component parts are indistinguishable from each other.
solution, saturated	one in which the solvent has taken up as much solute as possible at a given temperature and pressure
solvent	the liquid which dissolves a substance
spasm	a sudden violent involuntary contraction
spirit	alcoholic solution of volatile substances usually intended for internal use
sprain	the wrenching of a joint with partial rupture of its attachments
$\overline{ss}$	one half
stat.	immediately
sterile	free from all living organisms
sterilization	the process of destroying all forms of living matter
stool	excreta from the bowel
strain	to over exercise or use to an extreme or harmful degree; or, an over-stretching of muscle or tendon
stricture	the abnormal narrowing of a canal or passage
subcutaneous	beneath the skin
superior	above
syndrome	a set of symptoms occurring together
syrup	a concentrated solution of sugar in water, which may contain flavoring agents or medicinal substances intended for internal use
systemic	pertaining to the body as a whole

T

tablet	a compressed disk form of medicinal agent
therapeutics	the application of remedies and the treatment of disease
thoracic	pertaining to the chest
thrombosis	the formation of a clot within the blood vessels
t.i.d.	three times a day
tincture	an alcoholic or hydro-alcoholic solution prepared from animal or vegetable drugs or from chemicals. Tinctures of potent vegetable drugs are usually 10 percent in strength of the crude drug (each 100 cc. representing 10 grams of the drug)
tinnitis	ringing sensation in the ears
tissue	a group of cells together with their intercellular material united for a common function
tonus	normal "tenseness" of muscle
topical	local, or pertaining to a particular part
toxin	a poisonous substance
TPR	temperature, pulse, and respiration
transfusion	the transfer of blood from one person to another
transitory	not stable, passing
transverse	running at right angles to the long axis
trauma	injury of tissues by violence
tumor	a mass of tissue which persists and grows independently of its surrounding structures

U

ulcer	an open sore other than a wound
umbilical	pertaining to the navel
unconsciousness	insensible, not receiving any sensory impressions

V

vaccination	the process of inoculation with a vaccine
vaccine	any material for preventive inoculation
vascular	pertaining to blood vessels; or, richly supplied with blood vessels
vertigo	sensation of dizziness
vesicle	a small bladder or sac containing liquid
virulent	exceedingly harmful
virus	an ultra-microscopic agent capable of causing a disease
viscera	organs contained in the body cavities
vital	necessary for life
void	act of urination

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☆ U. S. GOVERNMENT PRINTING OFFICE: 1946—665613